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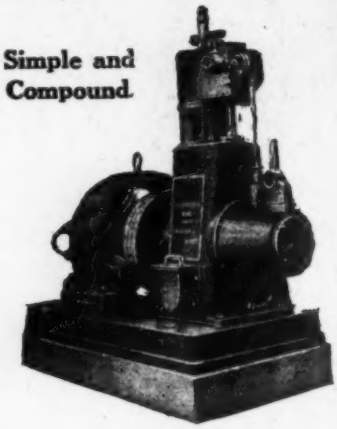

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THE GERMANS AND THE FEDERATION OF BRITISH INDUSTRIES.

THE Federation of British Industries appears to be gaining an unfavourable reputation in Germany, judging from two instances which have just arisen in that country. In the first place, the Central Union of the German Electrotechnical Industry (Central Verband der Deutschen Elektrotechnischen Industrie) has raised a protest against the Federation, while in the second, the latter's Export Register, or rather a card accompanying the register, has also evoked protest.

The Central Union has issued a statement which alleges that the Federation has succeeded in exercising a strong influence on the political economic measures of the British Government, examples of which are discerned in the abolition of the E.P.D. and in the fact that the Federation is consulted by the Government before any action is taken in the matter of political economic questions. The Union proceeds to state that those acquainted with British conditions know that the Federation has long been preparing the ground for anti-dumping laws, and the French efforts to burden German export trade with a 12 per cent. tax are said to be strongly supported in these circles, and certainly with means which cannot always be characterised as free from objection. A very popular means, the Union states, is for the Federation to get reports sent to it from its German correspondent concerning the situation of German industry and German trade, from which the conclusion can be drawn which is needed for its purposes. Unfortunately, it is asserted, there are now in Germany correspondents who apparently let themselves be influenced in order to represent the facts not as they really are, but in the form wished for by the Federation of British Industries, so that the latter can draw the desired conclusions by means of publicity. Thus, for instance, the correspondent of the Federation, after having previously utilised the high dividends of the German engineering industry as a basis, reports that as a consequence of the high costs of production in certain branches, the electrical industry is only able to carry on and increase its export trade by selling abroad at very low prices, and in point of fact at prices which are below the inland sale prices. The correspondent is alleged to have derived this from the "Official Labour Gazette"—a further misleading statement, for an official or prominent newspaper organ whose title could be so translated does not exist in Germany.

The Union goes on to say that the conditions are quite otherwise. The export prices which the German electrical industry is required to demand are fixed monthly by means of the co-operation of the individual trade groups with the Foreign Trade (State) Bureau for electrical engineering. In the case of countries having a high rate of exchange, as England, for instance, prices are still fixed at present considerably above the German inland prices in order in some measure to equalise the

difference in exchange. The Union does not know of any single product of the electrotechnical industry for which the fixed export prices have been below the home prices. The statement of the correspondent of the Federation, in the opinion of the Union, is consequently directly untrue. The correspondent who claims to be able to give an opinion on the situation of German industry must at least be so far informed as to know that the German Foreign Trade Bureaux never would give sanction to exports at lower prices than the inland prices, especially not in the electrical industry. If he was in doubt an application to the Bureau concerned would have been able very quickly to enlighten him. The Union remarks that the other representations of the correspondent, with regard to both the objectivity and accuracy of the statements, move on the same level as those respecting the electrical industry. In earlier reports the correspondent repeatedly also put forward the false assertion that the export prices were lower than the inland prices. Although the Federation when publishing the reports expressly points out in a cautious manner that it does not agree in all parts with the views of the correspondent, the Central Union submits that these representations find their way into the daily newspapers.

The second instance relates to the Export Register, copies of which are reported to have been sent to numerous merchant firms in Germany accompanied by a printed postcard asking whether the book met the practical requirements of the German merchant. Having regard to the decisions of the Paris conference, a German firm at Kiel, which had received a copy of the register, is reported to have sent a fairly long letter to the London offices of the Federation. The letter, although not of an electrical nature, seems worthy of being summarised.

The firm states that the Federation will probably meet with but little success with the register so long as the British Government continues to swim completely in the navigable channel of French policy and supports the latter's demands. "If you have a debtor," the writer states, "whom you burden with a load of debts of such a height that it is completely impossible for him to pay them, the consequence will be that the debtor, seeing the hopelessness of his efforts, will only work just as much as is requisite to defray the cost of his life maintenance, as he knows that he must deliver everything beyond that to his creditor. You may send the finest catalogue to him and quote the cheapest prices, but you will never receive an order from him because he has become incapable of buying through your attitude. The result will be that your finest efforts will take the way unread to the waste paper basket." After mentioning that before the war only English clothing materials were made up in the best tailors' shops, the writer states that England will never again attain to her former sales in this respect. He proceeds to remark that if no alterations in the Paris decisions were made at the London Conference, a boycott of English and French goods would begin in wide circles of the German population, so that no practical results would ensue from the sending of catalogues.

Supply Authorities and new Connections.

Judging by the number of inquiries that we are constantly receiving of late, with regard to the law on the subject of connecting new consumers to public supply mains, we are justified in deducing (1) that some supply authorities are making charges and imposing conditions for connections which are wholly unauthorised by law; (2) that there are many contractors outside the ranks of the Electrical Contractors' Association who in their own interests ought to be members of it; who, apparently, are totally unaware of the benefits and privileges to which they would be entitled, of the legal assistance that the Association would afford them, and of the information which would be at their disposal, if they were members.

With regard to the questionable conduct of the supply undertakers above referred to, we can do nothing but refer them to their own consciences (though it is alleged that a business corporation has no soul) in respect of the moral aspect of their procedure, and to their revenue account in respect of the commercial aspect of the matter. Who ever heard of a gas company which deliberately put obstacles in the way of prospective consumers? Absurd! The gas suppliers, who are all out for business, welcome new clients with open arms, and would rather pipe their houses gratis than lose their custom! Many electricity suppliers, on the other hand, still maintain that "take it or leave it" attitude, with the stress on the "leave it," against which we have so often inveighed, and apparently seek to choke off would-be consumers, by excessive (and sometimes illegal) charges for connection, and in some cases by excessive prices for electrical energy. Where the generating plant is fully loaded, and the Electricity Commissioners refuse to sanction extensions, it is true, new consumers cannot be coupled up; but the proper course is then to state the facts to applicants, and worry the Commissioners—no good manager in such circumstances would try to limit the demand by making overcharges, and thus creating an unfriendly atmosphere towards the undertaking which would persist in future years. Let us, in passing, hint a warning: Power users don't want to put down their own generating plant, or to drive their machinery directly from internal-combustion engines, but they will do so if they are not fairly treated by the electric supply authorities, and *in many cases it will pay them handsomely to do so.* Explosion engine practice is not standing still—far from it. Let those who would scoff at our warning give heed to Prof. Burstall's statements during the Birmingham discussion on the Severn barrage, and to the correspondence in our columns just before that time—notably to Mr. A. Hugh Seabrook's letter of February 11th.

Lastly, with regard to supply, we may point out that statutory undertakers are entrusted with a public service; they have no right to assume a domineering attitude; it is their plain duty to do their best to serve the needs of every person in their area who requires a supply of electricity, and wilfully to fail in this is to prove themselves unworthy of that trust.

Turning to the contractors who are nursing a grievance, in the *Electrical Contractors' Year Book* they will find a clear and concise statement of the law regarding the rights of consumers; in our opinion, if they do not belong to the Association, they are neglecting their own interests.

The Water Power Resources of India.

About eighteen months ago we discussed at considerable length the Preliminary Report on the Water Power Resources of India, which formed an admirable introduction to this important subject. A "Second Report" has now been issued dealing with data collected during the season 1919-20.* As regards definite progress, the Report is to some extent disappointing, but it must be remembered that a survey of this magnitude demands an enormous amount of preparatory labour and, before tangible results can accrue, investigations must be undertaken and records prepared on a scale out of all proportion to the staff and equipment available for the purpose up to the period covered by this Report.

There is every reason to believe, however, that the technical organisation is now in good hands, and that a sound, consistent and vigorous policy is being pursued in the acquisition of that information on which alone sound projects can be based. The present Report, in conjunction with the Preliminary Report, makes clear to everyone competent to assist in collecting data, exactly what information is required. In this respect the

* For particulars see our "Book Notices."

Reports may fairly rank as text-books which should be known and studied in every country where water power is available.

A second and more difficult and vital problem remains—that of regulating the control and development of water power. It is not sufficient to know that a certain amount of water power *can* be developed economically. It must also be ensured that it *will* be developed and distributed economically and fully, and that it will be sold at a reasonable price *regardless of the cost of other forms of energy*. The principle that water power—or any other form of energy—should be sold for what it will fetch must be excluded. National interests demand that energy—the key to industrial economy—should always be developed and sold at the lowest possible price consistent with a reasonable return on capital. Needless to say, this desideratum is far from being attained where coal and oil are concerned. In every undeveloped hydro-electric project we are "given a fresh chance" in this matter. Manipulation by financial interests must be prevented if the end in view is to be attained. This is a problem of the highest importance and greatest difficulty. Adequate financial backing is a *sine quâ non*, but the position of certain hydro-electric projects in America shows how easily public support may be enlisted for unsound schemes and how easily capital charges may be incurred which make it permanently impossible to sell energy at the true economic price.

The Report states that in more than one instance (in India) applications have been filed for the exclusive use of water power—the possibilities of which have been pointed out by the survey—with the admitted intention of selling the concession so obtained to the highest bidder. If such manipulation be permitted the consumer is for all time handicapped by the watered capital due to the bonus paid to the original speculator. Unless suitable safeguards can be incorporated in the form of lease or concession, the alternative of State control and operation of water power will apparently have to be adopted.

In the technical and financial control of water power development, India has an opportunity not only to serve her own best interests but actually to lead the world. This becomes more evident, the closer the consideration given to past and existing abuses, and to the magnitude of undeveloped hydro-electric projects as an antidote to the fuel shortage throughout the world.

The Report points out that there is much in favour of public utilities in general being operated by companies in which the municipality or Government is a powerful—if not predominant—shareholder. This system, which has given good results in Germany, appears to be a simple and effective method of safeguarding public interests whilst retaining the business methods of a commercial undertaking. If a hydro-electric project be operated purely under public ownership, it will be very necessary to keep accounts on strictly business lines—preferably, as suggested by the Report, by commercial accountants subject to audit by a chartered accountant. Due allowance must be made for depreciation and obsolescence, and a reserve fund is no less sound finance in a Government undertaking than in one under company management.

Turning from the political questions of development and control, which have been discussed at some length owing to their fundamental importance, mention may be made of the purely technical features of the Report. A series of diagrams is presented showing the varieties of "layout" usually encountered in hydro-electric work. These diagrams facilitate selection of the best method for dealing with particular sites. Many useful data are included bearing upon the development and storage of water for electrical purposes, and upon the estimation of power available. In order to be able to compare reports on sites it is desirable that data should be collected in more or less standard form—to facilitate which a form reproduced in the Report has been prepared.

Useful memoranda on pipe layouts are presented, together with two logarithmic diagrams showing the weight and safe working head for riveted steel pipes and for welded steel pipes. Important notes are included dealing with the use of aneroids in determining levels; serious errors may be made if the limitations of aneroid levelling are not recognised and the requisite precautions observed.

During the seasons 1919-20 a number of reconnaissances of power sites were made and checked, and the results of these are summarised in the Report. A good deal of additional power has been located and assessed, and it is anticipated that important progress will be made this season, now that the organisation for collecting information has been got into working order. Tabular summaries of all projects developed and investigated will, we hope, be included in future Reports.

It remains to be seen, from the work of the survey during the next year or two, to what extent it will be possible to develop the enormous water power of India at reasonable cost. In the meantime there are grounds for optimism not only as regards the outcome of this work and its influence on the agricultural and industrial future of India, but also as regards the beneficial effect of the hydro-electric survey of India in stimulating similar surveys, with equal benefit, in other parts of the world.

"Safety First."

There were 5,768 accidents in the power stations and on the distribution systems of New York City during the first ten months of 1920. Fifteen of these were fatal, and thirteen others involved grave injuries to individuals. It is strange to read reports of this nature from the country of origin of the "Safety First" movement, but the figures are official ones compiled by the New York First District Public Service Commission, and quoted by the *Electrical World*.

These statistics seem to indicate that the physicians, who so earnestly desired to eradicate the accident evil from the industrial life of England, are needed still more in their own country. No doubt the supply of electricity is carried out on a larger scale than in this country, but even this leaves a great deal to be explained. The causes of the accidents are not set out in the source of our information, but it certainly would appear that either the employés of the supply authorities were careless to a remarkable degree or adequate protection against accidents was not provided.

Whatever the cause may be, we think that a comparison of these figures, with similar statistics for the whole of the United Kingdom, will prove that the electricity supply industry is a much safer occupation in this country than in the United States.

The report of Mr. G. Scott Ram, M.I.E.E., H.M. Electrical Inspector of Factories, covering a period of four years from 1915 to 1918, showed that the total number of electrical fatalities during this time, including deaths in factories, &c., was 99. These figures, it must be remembered, covered the whole of the United Kingdom for four years, while the American figures relate only to New York City for a period of ten months.

Pit Bank Generating Stations.

After establishing generating stations at the pit bank, the next step as a natural corollary would appear to lie in the direction of the actual acquisition of the collieries themselves. This policy is now being pursued by the Rhenish-Westphalian Electricity Works Co., of Essen, which recently entered into an agreement with the Lignite Company owning the Rodder mine, and which is now taking over the management of three Stinnes collieries—the Viktoria Matthias, Graf Beust, and Friedrich Ernestine—for a period of 90 years. The supply company will guarantee a fixed rate of interest to the shareholders in the collieries, while at the same time the latter are giving the former an option to acquire their shares so that the pits will eventually become the sole property of the electricity company.

D

THE ELECTRICITY (SUPPLY) ACT, 1919.—OVERHEAD LINES AND WAYLEAVES.

By W. FENNELL, M.I.E.E.

Twelve months have now elapsed since Sections 21 and 22 of the Electricity Supply Act, 1919, provided what appeared to be large powers for the running of overhead lines in suburban and country districts.

The writer has, during those twelve months, been engaged largely on the arrangement and carrying out of overhead work, hoping thereby to make electricity available to outlying consumers who could not be economically reached underground.

Unfortunately, the Electricity Commissioners have been unable to devote their attention to the revision of Board of Trade regulations, and, moreover, Sections 21 and 22 of the 1919 Act are neither as lucidly drawn nor as helpful as they might be in the direction intended.

The removal of absolute veto of the local authorities, and the implied right of compulsory wayleaves in uninhabited districts, must be acknowledged with gratitude. In villages and suburbs, however, the clauses give no practical relief from the obstruction and greed of small owners.

The legal position with regard to overhead work is still one of restriction. The 1882 Act and Provisional Orders require the special consent of the Board of Trade to the placing of lines above ground, and the Board of Trade Memorandum, which is sent in response to a request for sanction, is still in the old form of a catechism, in which ingenuous questions are put respecting the proposals in matters which are covered by the Regulations themselves.

Section 21 of the 1919 Act enables the Commissioners to dispense with the consent of the local authority, but it very properly gives the latter the opportunity of being heard in opposition. This involves in practice at least three months' extra delay as compared with underground work, so that in urgent cases one cannot run overhead lines.

The first reform which the writer suggests is obtainable without legislation. Instead of individual lines requiring detailed sanction, the Electricity Commissioners might consider, with the first application for an overhead sanction, a plan of the whole area of supply, indicating by a coloured wash the areas for which the undertakers require a general sanction for overhead work. It would be as easy to settle this as one route, the files of the Commissioners would be relieved of the enormous masses of plans and papers which will accumulate under the present system, and in future there need be no delay.

Section 22 of the Act is badly drawn, and requires immediate reconstruction. Paragraph 1 gives permission to place electric lines underground, across any land, subject to the conditions of appeal, and it also gives permission to authorised undertakers to place any officially sanctioned electric line above ground across any land *other than land covered by buildings or used as a garden or pleasure ground*, subject to appeal. The reason for these absolute exceptions applying only to overhead lines is clearly a survival of prejudice. The Commissioners themselves cannot help us in such cases until the Act is amended. Overhead lines in villages and even in rural districts must, in a land of crooked lanes and roads, pass over buildings and gardens, even where the poles are in a public road or in a field along the back of a row of houses. It therefore is frequently necessary to cross a road, or otherwise upset the line, to avoid some crank or avaricious owner. There is no engineering reason for the exception of land covered by buildings; indeed, wires are very safe there, and an Act which prevents the Commissioners from sanctioning a crossing over a cowshed or a wash-house, or indeed any building, needs immediate amendment.

Again, why except "gardens or pleasure grounds" from the discretionary powers of the Commissioners? There are gardens and *adjective* gardens—small fields are said to be *market* gardens, allotments are claimed to be *vegetable* gardens, playgrounds *might* be called *kinder*gardens. In one case a heavy rental was demanded for crossing a grass-grown field which had a few fruit trees in it, on the ground that an orchard was a *fruit* garden. The only kind of garden one would not propose to cross is a laid-out garden of such an extent and degree of beauty that the presence of overhead lines would interfere with the amenities by introducing an incongruous element. The Commissioners have, however, power to prohibit in such cases, so why give an absolute exemption, and why submit to such loosely worded clauses? The wording of the Act can be twisted to exempt every cabbage patch or weedy forecourt and every chicken run. The Commissioners are entrusted with great powers—surely this very small one of seeing fair play can be placed in their hands.

There is another very objectionable feature of paragraph 1. Notice has to be served on the owner *and* occupier; and as each has the right of appeal it means double payment for one wayleave and interminable negotiations. Prior to the Act the procedure was to see the occupier, inform him as a matter of courtesy of the proposed work, obtain the name and address of the owner or lessee, and negotiate with the latter. The Act gives the tenant an absolute veto in the case of a line passing over a building or "garden," and appears to set up an entirely new vested interest, instead of regulating the old ones as intended. Incidentally, it enables a new tenant to require the removal of an existing line, although the property owner is satisfied that it may remain. The tenant, whose rights can only exist through his agreement with the owner, does not need this new protection; he has his remedy against the owner if his rights are infringed. Imagine the position of an engineer who has agreed with the local authority to supply a housing scheme (as the writer has done) by means of overhead wires run along the back line of semi-detached houses, crossing the gardens from house to house. He must start off to bargain with hundreds of occupiers, weekly tenants perhaps, before they come into residence. Suppose only one objects, this means a hold-up for two or three months while the local authority gets rid of the obnoxious tenant. Whoever drew this clause was totally ignorant of the practice of the Post Office or of any public utility undertaking in respect of wayleaves. This double bargaining really must come out of the Act.

The remainder of paragraph 1 gives the Commissioners power to grant compulsory wayleaves in those cases where the exception does not apply, and where consent is unreasonably withheld. The writer has never been able to try the effect of an appeal to the Commissioners—those objecting owners who came under this clause have always given way on the suggestion of an appeal. The difficulty has always been with the numerous cases where the wording of the Act has made it impossible to appeal, so the objection has been overcome by the usual means—an extortionate payment—or the route has perforce been changed. It would appear, therefore, that to put matters right in sub-section 1 it is only necessary to cross out a few words so that the Commissioners' power shall extend to all cases, and to confine the negotiations to owners or lessees.

In paragraph 2 of the section, one gathers that undertakers may cross railways and canals from side to side, by giving the same notices as for crossing streets. It is, however, being argued that the words "subject to the rights of the owners thereof" mean that instead of being released from former restrictions caused by private ownership (which had to be overcome by wayleave payments and expensive agreements—the latter running into 20 pages in some cases) we have all the old disadvantages, and the further yoke has been placed on us of

having to give statutory notices. Of course this is absurd. The opening words are "the power conferred, &c." (see above) "shall include the power of placing lines across, &c." If the ingenious arguers are right, we should be better off without the boon "conferred" upon us. A few words inserted in the 1920 Bill would put an end to this word-juggling. In order to show the urgency of this matter it may be mentioned that quite recently £5 per annum, plus a costly agreement, was demanded by a canal company for a service line crossing over a canal—no poles even being on the company's land.

The next urgent matter is the drafting of an up-to-date set of regulations, as clear as those for underground work, based on present-day knowledge and experience. One recognises that the Commissioners cannot do everything at once, but a perusal of the Regulations will show the real need for expedition.

This subject should be approached from the point of view of encouraging the use of overhead wires for giving supplies in sparsely populated areas, having in mind the national interest, rather than that of the conditions of supply in cities and large towns, which were formerly the only ones likely to arise.

The new Draft Regulations should be left open for discussion in the Press, and should come before a special Committee of the Institution of Electrical Engineers (not a Committee of the Council, which would probably be composed of City supply engineers). After this inquiry the Commissioners should reconsider the draft and issue their regulations. If the regulations are properly drawn there will be no need to catechise the engineers as to their intentions, just as it is not necessary to do so to-day in the case of power stations, mains, sub-stations, services and meters.

It will be seen from the wording of the Low and Medium Pressure Regulations that they were for the most part drawn many years ago, when the engineering of overhead work was not in an advanced state. The object in view was not so much the minimum requirements reasonably to protect the public as that of making it impossible for any injury to result to the most careless member of the public, irrespective of expense to the community. If the rules were drawn on these lines for gas supply, or for tramways, road traffic, or even ordinary electricity supply, there would be an end of public utilities. Imagine a gas supply given in such a manner that the gas could not escape unlighted, or a gas jet placed under a ventilating cowl leading directly to the open air, or lamps in public buildings and roads placed at a height of not less than 22 feet from the ground on unclimbable poles. Conceive a limit of 250 volts d.c. (or 125 volts a.c.) for unguarded tramway overhead lines, and where the pressure exceeds that, a guard so arranged that a falling wire must be caught and earthed. Visualise a double decker provided with an earthed wire-work or expanded metal cover and sides. The brain reels before the idea of drawing regulations to secure a dangerless street. Obviously all ponds, canals, rivers, and railways should be guarded along their entire length by unclimbable fences—having a height of at least 8 feet. Deaths due to drowning are very numerous, and the probability of walking into a canal exceeds that of being struck by a falling wire in the ratio of a thousand to one. The above suggested crazy regulations are, in fact, just as necessary for protecting the public from the risks they run daily as are the majority of those for overhead wires. It is simply the familiarity of the old set of risks which minimises their apparent importance. The public is to-day being protected from ordinary traffic risks by a "safety first" educational campaign—not by restrictive regulations. Why not extend the movement, adding the following maxims?:—

"Safety first—look up and move on!" Or, "Yes—they *might* fall—*need* you loiter?"

It is too much to expect that we shall be allowed the same "right to kill" as that accorded to gas and transport authorities, but the criticism of the regulations does show that while there is a certain reasonable standard of precaution which should be taken, there are also certain commercial risks which must be run if the best interests of the public are to be served. It is also fairly clear that a thorough investigation is needed into the restrictions imposed on overhead work in this country, with a view to the removal of all unnecessary handicaps.

Widespread distribution of electricity is now being undertaken in sparsely populated areas where overhead mains form a suitable and reasonably cheap method of supply. The cheap and abundant supply that we hear so much of will never be given by retaining expensive and cumbersome regulations, nor by exposing distributing authorities to continual extortions of unreasonable owners and occupiers along the "rivers of electricity" which may be thinned down to brooks in the guise of No. 11½ S.W.G. service lines along the back gardens of our villages.

There is another matter requiring serious reconsideration—namely, the position of H.M. Postmaster-General in relation to overhead lines. The privileged position of telegraphs and telephones is one requiring very delicate handling. The defect of the present arrangement is not so much the rules made by the G.P.O., sometimes contrary to technical accuracy and reasonableness, as the fact that there is apparently no appeal in respect of their application to anyone but the Postmaster-General, which in fact means the official who made or interprets the rule, and whose experience is confined to his own work. Surely this is a case where the Commissioners should be constituted as an appeal authority to act in conjunction with the chief engineer of the G.P.O.

JOINT ELECTRICITY AUTHORITIES.

Mersey and West Lancashire Inquiry.

Three days sufficed to complete the resumed inquiry by the Electricity Commissioners in connection with the scheme for the constitution of a Joint Electricity Authority for Mersey and West Lancashire District. Summarised, the proceedings of the inquiry have revealed (1) a strong opposition on the part of the Birkenhead and Wallasey Corporations to inclusion in the big scheme (Scheme A) and they made a proposal for the constitution of an electricity authority for the Wirral peninsula (Scheme B); and (2) the antagonism of the Mersey Power Co., which objected to the inclusion of its undertaking in any scheme which the managing director called "communal control," because it believed that the best results had accrued, and would continue to accrue, from private enterprise. On the concluding day of the inquiry, which was continued to a late hour, the Commissioners intimated that to save time, they would accept up to Saturday (March 12th) written statements on behalf of the smaller local authorities. This would make it unnecessary for speeches to be made on their behalf. On Friday (11th inst.) the Commissioners visited the much debated and growing industrial district of Ellesmere Port, where an electricity supply had been held up for some years owing to the local council's not acting on a Provisional Order. They also intended to visit the Mersey Power Co.'s works at Weston Point, and other stations, as time permitted.

The Commissioners were Sir John Snell (chairman), Sir Harry Haward (vice-chairman), Mr. H. Booth, and Mr. W. W. Lackie. They were accompanied by Mr. E. W. Hudson (legal adviser) and Mr. D. S. Cumberledge (clerk).

On Tuesday (8th inst.) Mr. Honoratus Lloyd, K.C., for the promoters of Scheme A, intimated that he had received a letter from the town clerk of Warrington stating that the council had come to the conclusion that the present time was inopportune for schemes of great capital expenditure, and requesting the Commissioners not to proceed with the constitution of the joint authority. Mr. Lloyd also read a letter and a resolution from the St. Helens Council stating that, having regard to the evidence of Mr. Dickinson (Liverpool electrical engineer), and the attitude of several of the local authorities, it could not give further support to the present scheme.

The Chairman asked the representatives of the two councils to give an explanation of their reasons for the withdrawal, but they considered the time inopportune, and promised a statement later.

The Chairman said that in the recess the Commissioners had applied themselves to the figures which had been submitted by both sides, and as a result they intended to invite counsel for the two schemes to meet them that afternoon in order to go into figures which the Commissioners had prepared. If necessary they would recall Mr. Dickinson and Mr. Sparks to speak on them. He also invited counsel for the Mersey Power Co. and the representatives of St. Helens and Warrington. After all, the Commissioners were there to bring

about improvements in the organisation of the supply of electricity in the district, and it did not help them very much when authorities, without giving reasons, withdrew from the scheme.

The case for the Mersey Power Co. was then opened by Mr. Tyldesley Jones, K.C. He said that the scheme for the Mersey and West Lancashire electricity district, which had been proposed, should not include the district in which his company operated, as it could be better dealt with by the Mersey Power Co.'s undertaking at Runcorn. That was the first big inquiry under the Electricity Supply Act of 1919, in which the principles that would be drawn would come into very great prominence. The circumstances of the Llandudno and North Wales inquiry were entirely different. In dealing with a district where there were so many undertakings, municipal and otherwise, the Commissioners should consider very carefully what would be the effect on the future of the supply industry of a decision on the issues which would come before them. These matters were to a large extent technical, but they also, to a large extent, involved considerations of public policy and business policy. The first consideration he desired to emphasise was that in laying down a policy which would be adopted in other areas, the Commissioners should put in the forefront fair treatment for existing undertakings. It would be fatal to the future of electricity supply in the United Kingdom if those who had brought about the supply that existed to-day had their interests sacrificed in the pursuit of some idea of an age when all authorities in the district would meet harmoniously and settle to their mutual advantage questions of policy involving discordant interests. The second point which Mr. Jones desired to emphasise was that in every scheme which was put forward under the Act, compulsion was and must be absent. If they had certain areas where the supply was efficient and authorities could combine for producing a greater efficiency, it would be a perfectly proper thing for them to combine, but if they found in one of those districts a highly organised supply of electricity, and that no benefit was shown to that or any other district, then there was, he submitted, no case for including in any scheme embracing those districts if it would be disadvantageous to those that were highly organised. There was no foundation for the idea that compulsion would be applied to bring an authority into the scheme. The Mersey Power Co. supplied Widnes and Runcorn. The Urban District Councils had electricity orders for many years, but nothing was done. Both places were important industrial centres; there was a load waiting for the supply, there was the local authority, which had the financial ability to raise money on the rates to provide the supply, but what was lacking was the business enterprise. The Salt Union had vast interests in the valley of the Weaver, and the idea was conceived of producing electricity by the use of waste heat. In 1910 a new Order was granted for Runcorn—a remarkable one, because the maximum price was to be 4d. per unit. There was no other Order that he knew of where such a price was included. Nine-tenths of the output of the Mersey Power Co. was for power purposes, and it was supplying at the same price as before the war, except that in many of the contracts there was a coal clause by which the increase in the cost of coal was put on to the consumer. His company supplied in its first year, 1912, one and a half million units; in 1920 the number of units was 25,000,000. The average price was 1d. per unit. New industries had been attracted by the cheap power it supplied.

The company desired to supply Ellesmere Port, and since 1911 negotiations had been proceeding with the local council, but until recently they could get no further. His company supplied 369 units per head of the population of the district which it covered, compared with Liverpool's 95 and St. Helens' 129.

Sir Harry Haward questioned the fairness of such a comparison, and Mr. Jones replied that Liverpool had been at work 38 years, whereas they had only been at it for a comparatively short time. Of course, the chemical factories were large consumers.

Mr. Jones, continuing, asked if the efficiency possible in his district was going to be enhanced by being grouped with Liverpool, or was the efficiency of Liverpool going to be enhanced by being grouped with the Mersey Co. There was nothing in common between them.

Mr. G. W. Malcolm, managing director of the Mersey Power Co., said the company was formed to work the Electricity Orders for Runcorn and Widnes. It was his original idea that the Salt Union, the owners of the Power Co., should produce electricity in 1909. The company was putting up a new station that would have a capacity of 25,000 kW—two sets of 12,500 kW—and there was an idea of ultimate extension to 100,000 kW. There were production possibilities for the use of waste heat from salt, and they were being investigated by the experts of the Salt Union in connection with processes employed by them. Waste heat was now being employed in connection with their electricity undertaking. At Winsford there were 12,000 tons of waste steam each week from the salt pans, and in his opinion there was no inherent difficulty in arranging pan covers to trap the steam. The main obstacle was one of capital outlay. He felt that his firm would be hampered by being brought into an electricity district.

The Chairman: Why?—Because of communal control. We are certain that private enterprise can do better than large unwieldy bodies. Private enterprise alone can develop the industry.

Mr. Malcolm added that within three months his company would be supplying Ellesmere Port, and as soon as the load warranted it the company would probably be prepared to extend the area of supply. If it were left out of the Joint Authority, it might be an advantage to it to join with electricity authorities on the east, west, and north. It would willingly give any help it could on commercial terms, but he objected to control in any shape or form.

Cross-examined by Mr. Honoratus Lloyd, who appeared for the promoting authorities, Mr. Malcolm said that at one time the company regarded electricity as a by-product, but not so now. He objected to control by anybody but the Commissioners. He regarded a spirit of rivalry as the main spur to efficiency. Within three months from now the output from waste heat would be relatively insignificant, owing to the erection of the large steam power station.

In re-examination, Mr. Malcolm said that vacuum plant was used for making salt and absorbing heat from the turbine exhaust. When the heat was not required it was used for making electricity. The private companies, he thought, were being shabbily treated in the matter of representation on the Joint Electricity Authority. They were the second largest distributors in the area, but if all the distributors had representation, the number would make the authority unworkable and unwieldy. They had had a loan of £300,000 from the Ministry of Munitions for the new 100,000-kW power station. The present cost of the building was £487,000. The Mersey Power Co. would be willing to supply electricity to the Joint Electricity Authority, on usual terms.

Replying to Mr. Cowley (Northwich U.D.C.), whose questions were addressed through the chairman, Mr. Malcolm said that the electricity supply of the company would be extended to Northwich as soon as the load could be obtained. He thought that the charge for electricity at Northwich would be the same as at Runcorn, plus capital on mains only.

Mr. James Nelson, electrical engineer to the Mersey Power Co., said that last year they supplied 25,000,000 units, of which 12,000,000 were taken by the United Alkali Co. Two cables were now being laid to Ellesmere Port, to convey 5,000 kW at 5,700 volts; the route was along the Ship Canal. Developments were taking place on the river Weaver, and they were preparing to deal with them. They had no intention of increasing the rates when the new power station was opened.

The inquiry was then adjourned.

When the inquiry was resumed on Wednesday morning, Mr. James Nelson was cross-examined by Mr. Woolf (junior counsel to Mr. Honoratus Lloyd, K.C., for the promoters). He stated that the load factor of the system in 1920 was 59 per cent., and included the 12 million units supplied to the United Alkali Co., whose load factor was 90 to 94 per cent. There were 1,013 consumers connected with the Mersey Power Co.'s system, 950 being lighting consumers and 63 power consumers. Outside of the United Alkali Co., their main consumer took 3,500,000 units last year. The maximum load in 1930 was 4,400 kW. Nine shillings was the basis of the coal clause, and the average price of coal was something under £2.

It was suggested to witness that the object of the Mersey Power Co. had not been to provide a supply of cheap electricity, but to secure the profits from a large supply. He replied that to obtain the profits they gave a cheap and abundant supply. He admitted that their operations in Runcorn and Widnes were started at a very felicitous time. The profits of the company increased during the war, and at the close of the war it was decided to erect a main generating station. The Ministry of Munitions encouraged the idea, and had mortgaged the property to the amount of £300,000. If it were possible to lay down a new system it would be quite different to the existing system from the electrical point of view. The system, under the modern conception, would take the form of a very large generating station with a view to securing the maximum efficiency and economy. Big consumers, he thought, were likely to take their supply from very big undertakings rather than from small undertakings, because they would be more conducive to a diversity of the load, and more likely to secure and promote electrification by the railway companies. At the present time the company was supplying energy more cheaply than any of the authorities, and the average prices were less than those suggested under the scheme.

The Chairman: The scheme does not mention any prices.

Mr. Nelson added that it was part of the policy of his company to obtain Provisional Orders.

Mr. Tyldesley Jones, K.C., explained that negotiations were attempted by the Mersey Power Co. with the Ellesmere Port Council on three alternative bases, such as taking over the order and accepting the responsibility of supplying everybody, and the company giving a bulk supply, leaving the Council to supply the big users. The third was not agreed to. The Ellesmere Port Council asked for 150,000 units per annum rising to 5,000,000, which Mr. Jones suggested showed how little the Council appreciated the present position. Between Runcorn and Widnes, the company had two overhead cables, over the river, and one over the transporter bridge.

Replying to the Chairman, Mr. Nelson said that it was his opinion that the continuance of local power stations was not desirable if it could be avoided. In the course of time,

they would, he thought, be used as sub-stations, and not as generating stations. The chemical load was practically a continuous load, and was peculiar to the district. He estimated that the load in the year 1930 would be 22,000 kW.; that excluded transport and a certain consumer.

The CHAIRMAN considered this figure very conservative.

WITNESS, continuing, said that the Weston Point station could be designed to have an effective load of 100,000 kW. Asked what they would do with the balance, Mr. Nelson said that it would not be produced until the load warranted it. He agreed that they would have to supply Northwich, Middlewich, Warrington, and St. Helens to utilise their capacity fully.

Mr. WILLIAM MCLELLAN, consulting engineer to the Mersey Power Co., said that the new power station of the company should not necessitate increased charges. The company was a small undertaking which was an excellent example of a system excellently handled and developed. The proposed Joint Electricity Authority could not supply in the company's area at lower rates than were now being charged, having regard to capital costs. It might be possible to utilise steam from the open salt pans, and this was a question very present in the minds of the directors of the Salt Union. They would not be benefited by the Joint Electricity District, because the Mersey Power Co. had a very efficient system, and could supply as cheaply in the future as now. Their new capital station would compare with the station at Liverpool. Administration was a matter of vital importance, and should be managed by a small body. The United Alkali Co. had two 5,000-kW sets. He thought the cost was £470,000 capital outlay, or £94 per kW of operative capacity. From the technical point of view, he thought there should be a linking-up of capital stations in the area, the stations mentioned being the Riverside, Wallasey, and Weston Point stations. He feared that the proposed Joint Electricity Authority would be composed of warring elements. It was difficult to get local authorities and councils to act together. If they were prepared to sink their personal differences and think only of cheaper electricity, he thought there would be some possibility of progress, but local authorities would not do this. He thought *all* Joint Electricity Authorities would be cumbersome and some impossible. As to the provision of the capital required for laying cables, he was of the opinion that this would be a difficult problem. He would not put down two stations within five or six miles of each other, but taking the whole of the area, he thought the district could be economically supplied from two stations situated east and west. Difficulties arose, however, on questions of administration and policy. He did not think that the enhanced cost of plant and money had rendered less desirable the general principle laid down in 1918, and generally accepted by the electricity industry with reference to schemes for the generation of electricity. Witness would not put capital stations at Northwich and Winsford.

On behalf of the Manchester Ship Canal Co., Dr. EASTHAM asked: (1) When would the Mersey Power Co. give a general supply of electricity to Ellesmere Port and district, and (2) What was the earliest time this district could be supplied if the big scheme was sanctioned? To these queries it was replied that if the Commissioners granted an order under Section 6 of the Electricity Supply Act to the company, a supply would be available in June.

Mr. MALCOLM was recalled, and said that the profits of his company in 1916 were £23,709 (dividend 20 per cent.), 1918 £25,500 (dividend 32 per cent.), and 1919 £17,203 (dividend 10 per cent.).

This concluded the case for the Mersey Power Co.

Mr. J. E. SINGLETON appeared for the Runcorn Rural and Urban District Councils, and said their case was bound up with that of the Mersey Power Co., by which they had been supplied for some years. The Runcorn authorities took up the position that they had a cheap and abundant supply of electricity, and that there was no prospect of getting a supply more abundant or more cheaply, therefore they said: "Leave us alone." If the Mersey Power Co. were impressed into the scheme it would mean that any balance of power would go Liverpool-ward, instead of southward—the river Weaver district, which was the hope of the Runcorn district. If they were included in the scheme their representation would work out at 0.25 or less member. He asked that the Commissioners should give the matter consideration.

At this stage of the proceedings, Mr. W. H. ANDREW, town clerk of St. Helens, explained why his Corporation had withdrawn from the inquiry. Its first inclination, he said, was to sit tight and say nothing. It thought it could produce electricity more cheaply than the proposed Joint Electricity Authority, but recognising the advantage of co-operation, it went so far as to be prepared to make a monetary sacrifice. There was a strong suspicion that the backbone of the scheme was mainly to boost up Liverpool at the expense of her neighbours. There was also talk of schemes for a super-power station; they in St. Helens said there was no necessity for a super-power station. If the Commissioners could evolve a smaller area, satisfactory to them, they would sink their differences and come in.

The CHAIRMAN put a number of questions to Mr. Andrew, whose replies tended to ambiguity. One question was: "Is the reason why you have seceded because you are advised that both now and ten years hence it will be cheaper for St. Helens to remain aloof?" to which the answer was that the Corporation did not think that the area scheme would be a success. Sir John Snell observed that the attitude of St. Helens was not very helpful to the Commissioners.

A solicitor to one of the railway companies asked the town clerk if the Corporation could supply his company with 700 kW, rising to 1,500. "When we get our new station," replied the town clerk.

Mr. ARTHUR COLLINS, a financial expect and the city treasurer of Birmingham, then entered the witness box. He said he was dealing with the financing of six area schemes. There were three essential points upon which he thought every local authority participating in that or any other scheme should consider before committing itself: (1) Methods of dealing with existing stations; (2) methods of payment for such existing stations; (3) security for capital issued. The success of the scheme to a large extent depended upon existing authorities having control of the present stations. There would be a risk in proceeding with a capital station unless and until those responsible for the technicalities knew and could do just whatever they pleased with the existing stations. His propositions for disposing of the difficulties regarding the existing stations were: Control with acquisition; no compensation, the authority may close down stations and leave the debt a burden on the local authorities; consideration of the matter by authorities before they subscribe to the scheme in order that they may know the measure of agreement likely to be reached before handing over their individual stations; take over stations at capital cost; acquire stations at their then value, under the Electric Lighting Acts, which would mean a great deal of arbitration; and take over the stations on a valuation determined by the Commissioners, which would apply equally to the companies and authorities. He suggested the following formulæ in connection with the last consideration: Valuation on the basis of the capital value per kW available, the value sliding up or down according to its capacity for cheaper production, corrected by differences in the unexpired life of the undertaking. The question of finance was a very material factor in an electricity scheme. He was inclined to place the acquisition of the stations as a first consideration, and he did not think the authority should proceed with a capital station without first being sure of the existing stations. The capital required for the Wirral scheme he considered was not beyond the capacity of the Birkenhead and Wallasey Corporations, but at the same time he was prepared to admit that Liverpool was in an exceptionally favourable position for raising money cheaply. The Birkenhead and Wallasey Corporations under their scheme would require £250,000 within the next few years and, owing to high cost of construction, plant, and money, he thought it best for authorities to extend existing stations to meet a reasonable demand rather than commit themselves to a super-station based on an optimistic estimate.

Sir JOHN SNELL remarked, after an examination of some figures put in evidence, that it appeared that Birkenhead and Wallasey would spend more money in executing the Wirral scheme than they would be called upon to pay by participating in the larger proposal.

To abbreviate the inquiry, the CHAIRMAN at the outset of Thursday's proceedings suggested that written statements should be handed in by local authorities and interested representatives, instead of verbal statements being made.

Sir JOHN SNELL asked the clerk of the Ellesmere Port Council why the Order which had been obtained in 1913 had not been put into force.

Mr. FRANCIS replied that subsequent to obtaining the Order, the Council acquired the gas undertaking, and negotiations proceeded with the Mersey Power Co. in connection with a bulk supply of electricity to the district, but the company was anxious to obtain a transfer of the Order, or if that were not permitted, to supply the large power users only. The Council was desirous of working the supply itself, so the negotiations fell through. They were reopened in 1917, but owing to Treasury restrictions on borrowing, the Order could not be put into operation. In October, 1918, they received communications from the Board of Trade suggesting that they might obtain a bulk supply from the Mersey Power Co. Last year they approached the company and asked for terms for supplying 150,000 to 5,000,000 units, but the company was not prepared to give a bulk supply. The Ellesmere Council felt the local authority was the right authority to operate the Order. It had been somewhat prejudiced by the Section 6 orders issued to the Power Co. If the Joint Electricity Authority was established he thought the Council would still desire to be the local distributors. It would like the Mersey Power Co. to let it have a bulk supply until the Joint Authority could let it have, at some future date, a cheap and abundant supply of electricity. The policy of the Council was to furnish manufacturers with the cheapest electricity supply possible, and it did not want to make any profit at all. The development of the district depended upon an adequate electricity supply being forthcoming. It was absurd to say that the Council had desired to hold up the electrical development of the district owing to the gas undertaking. It did not supply gas to manufacturers for power purposes.

The CHAIRMAN: I infer that whatever the Commissioners conclude would be the best method of getting the cheapest supply of electricity to all classes of consumers at Ellesmere

Port, that decision would be loyally supported by your council? —Undoubtedly.

Mr. W. Sparks, who appeared for the Birkenhead and Wallasey Corporations, in support of the Wirral scheme, said that the first development of the Wallasey station would cost £252,000, and the second £440,000. Electricity could be provided more cheaply by the Wallasey scheme than by the larger scheme. Answering the chairman, he gave details of the proportion of expenditure by the Wirral authorities of Birkenhead and Wallasey, to the total of £4,461,000, which Mr. Dickinson had put forward as the total expenditure on scheme "A." The division of the big area into two districts with the separate development on the north and on the south side to meet the estimated requirements of 1925, would as two separate districts represent a smaller expenditure than as a combined scheme.

The Chairman: Is it your considered opinion that large systems cannot be economically introduced into this country? —I am afraid it is, owing to the difficulty of financing them at the present price of plant. We have to accept compartment development to-day as against comprehensive treatment. Ultimately he admitted compartment schemes involved a bigger expenditure. Conditions in the American electrical industry having been mentioned, the same difficulty was being met there, he said; it was world wide.

Witness, in answering a series of questions, admitted that the continuance of small concerns would have an adverse effect upon the utilisation of electricity by the railway companies. He thought grouping might be accomplished on a smaller scale.

This concluded the case for the Wirral authorities.

Mr. H. Dickinson, electrical engineer to Liverpool Corporation, said it was desirable that the existing electricity stations should be under the absolute control of the Joint Authority, and so far as he was aware, all the promoting authorities of the Mersey and West Lancashire scheme were prepared to hand over, on terms, their stations.

Concluding Speeches.

For Wallasey, Mr. Jeeves, K.C., said that though no plans had been prepared in anticipation of the end of the war, delayed extensions had since been carried out, and a large amount of modern plant had been, and was being, added to stations. They were not now in the position to bear a burden that would not fructify until ten years hence, as they had more than enough to do to meet immediate requirements, owing to the great scarcity of money. Wallasey was now putting in 5,000-kW sets, and when the demand developed would put in another 10,000-kW set. Adequate and cheap capital was necessary to obtain a cheap supply. There was complete agreement between the authorities concerned in the Wirral scheme, and although it had been suggested that the bigger scheme went further in the same direction—with which he did not agree—the measure of co-operation between Birkenhead and Wallasey ensured their scheme being put into practical operation, and not being stillborn. So far as he had been able to see there had not been the same co-operation between the authorities affected on the north side of the area. He submitted that the balance of the evidence showed —under scheme B—electricity would be provided quite as cheaply as, if not more cheaply than, under scheme A. Wallasey and Birkenhead were prepared to pledge their credits on their scheme and to meet any deficiency there might be.

For Birkenhead, Mr. Miller, K.C., said that his clients were uncompromisingly opposed to inclusion in scheme A. The Wirral scheme had been propounded by Wallasey, and was supported by Birkenhead. There was no benefit to them in the Wirral being included in scheme A, because they could obtain for themselves an abundant supply of electricity, and the objects of the Act could be attained in their district without shouldering any of the obligations of the big scheme. He thought that it would be found that his district could be supplied from the extended existing station at Wallasey more cheaply than from a capital station under scheme A, assuming that it came into existence. They did not want to join the large area, because of its commitments, and because they did not think it would work. There was no measure of agreement between the northern authorities as to the terms under which stations were to be taken over, and scheme A itself seemed to be based on a pious anticipation that things would go well. The Commissioners could issue an Order for scheme B with the definite conviction that all would go well, that the plans formulated would be carried out, and that the people would get the cheap and abundant supply of electricity that the Act contemplated.

For the Manchester Ship Canal Co., Dr. Eastham said that in the Mersey and West Lancs. area his company had 16 miles of canals, and owned 2,500 acres of land adjoining the canal, which would be developed as industrial areas. There was an urgency in the need of the supply of electricity for Ellesmere Port. The interests of his company lay (1) in getting a supply, and (2) getting it cheaply. So far as scheme B was concerned, they objected to that because it gave them no benefits at all. It was too small, and did not deal with admittedly industrial areas. As regarded scheme A, his company opposed this also. The main objection to scheme A was that the Ship Canal Co. might be left without a supply for some years to come, and that was a serious matter. At Ellesmere Port and district they were crying out for electricity. The Mersey Power Co., a very enterprising concern, had exceptional facilities, and the directors of his company said: "Do everything you can to enable the Mersey Power Co. to extend their activities in the area they supply and the adjoining areas." There was a demand for electricity on the south side of the river Weaver. If scheme A were modified so that the south bank of the Mersey was brought in, he would ask the Commissioners to see that the industrial areas which depended upon a cheap supply of electricity had their needs attended to at a fixed maximum price. The Mersey Power Co. could supply cheap power, but if the big scheme were passed there would be a levelling up in prices, and they would lose an advantage by the Power Co. being taken over. If they could have a Joint Authority taken over by the Commissioners they would be satisfied. As for representation on a Joint Authority, they thought they should have at least one member. His company was not concerned who gave the supply, but it was most anxious to see that the area secured one that was plentiful. It considered that the Mersey Power Co. was the best means.

For Warrington, Mr. Woolf said that it was not antagonistic to the Joint Authority, but the borough was not favourably impressed by scheme A. The Corporation would consider the modified scheme on the lines suggested by the Commissioners.

For the railway companies, Mr. Tyler said that he represented all the railway companies excepting the L. & Y. Co., the Overhead Railway, and the Mersey Railway, and their view was that there should be some unification of control. The Mersey Power Co. and St. Helens affected the railways to some extent. The railway companies' experience of St. Helens had been unfortunate. Ten years ago they asked St. Helens for a supply for their works at Earlstown, which was outside the boundary, and difficulties arose which could have been surmounted if St. Helens had so minded, but no supply was forthcoming. They applied again recently, but St. Helens said it had not the plant. The railway companies preferred that St. Helens should not be included in the area scheme.

For Bootle, Mr. Clothier said that scheme A did not commend itself to his clients, who claimed it as their right and duty to maintain their own system of supply from their own undertaking.

For the Mersey Docks and Harbour Board, Mr. Stewart-Brown said that the board objected to scheme B, because it split the area into two smaller districts. Their estate lay on both sides of the Mersey, and the acceptance of the Wirral scheme meant that they would be within the jurisdiction of two Joint Authorities, which, from their point of view, would be a deplorable and impracticable result. The board would like to see a representative of the commercial, as distinct from the industrial, interests, on the Joint Authority.

Bebington U.D.C. favoured the large scheme (and handed in photographs and maps of their district), as also did the Formby Council.

For the promoters of the Mersey and West Lancashire scheme, Mr. Woolf, in the concluding speech, referred to the Mersey Power Co. as the electrical "Jack Horner," who having got two good plums wanted more. It was for the Commissioners to say how far aggrandisement by a private company was to go, but he was bound to confess that the company's scheme was more ambitious than he contemplated. For scheme B there seemed a remarkable absence of support. It consisted only of the two promoting boroughs and thirty villages with a population of 19,000 people. The major scheme, on the other hand, had the support of the commercial and industrial communities on the north of the Mersey. His clients said that a new main capital station was essential, and it must be on the Lancashire side where the load was densest.

Sir John Snell, on behalf of the Commissioners, expressed their thanks to Mr. T. C. Wilson, chairman of the Conference of Local Committees, and Mr. H. Dickinson, the Liverpool electrical engineer, and Mr. E. W. Pierce, the deputy town clerk, for the efforts they had put forward in connection with the preparation of the scheme.

Neon Lamps.—A recent paper in the *Zeitschrift für technische Physik*, abstracted by the *Technical Review*, describes neon arc lamps manufactured by the Studien-Gesellschaft für Elektrische Leuchtröhren m.b.H.

Each lamp consists of a glass tube filled with neon at low pressure, and provided with two or more electrodes. The cathode consists of an alloy of the alkali metals and other metals. The alloy is solid, even when the lamp is burning. The lamp is designed for use with direct current at 220 volts; the current required is about 1 amp., a suitable resistance being introduced in the circuit. In order to strike the arc a vacuum interrupter is connected in parallel with the lamp, a small choking coil being inserted in the common portion of the circuit. An inductive impulse set up by the automatic action of the interrupter by means of a magnetic coil, causes a discharge through the lamp. The colour of the light given out by the lamp is red, and is therefore specially suitable for advertising, signalling, and medicinal purposes. The lamp uses about ½ watt per candle-power, and has the great advantage over other vapour lamps that it can be lit and put out very quickly (as often as 400 times a minute).

THE DEGASSING AND PURIFICATION OF BOILER FEED-WATER.

By PAUL KESTNER.

(*Abstract of paper read at a Joint Meeting of the* Institution of Mechanical Engineers *with the* Society of Chemical Industry.)

The author deals in this paper with the process of continuous blowing down used in conjunction with hot purification. Hot purification effects a thermal saving, and has the further advantage of eliminating the gases dissolved in the feed-water, by the reduction in solubility at high temperature. The speed at which the reaction takes place in the purification of water by soda alone or lime and soda can be accelerated by heat, and the settlement of the precipitate can be hastened by agitation, the effect of which is to cause accretion and increase of size of the particles. If the agitation is caused by a stream of water carrying air with it the water becomes saturated with oxygen, and corrosion results.

In water-softening processes generally rise of temperature ensures:—

(*a*) Increased speed of reaction.

(*b*) Reduced viscosity of the water.

(*c*) The reduction of the bicarbonates of the alkaline earths to carbonates.

(*d*) Reduced solubility of calcium sulphate and partial precipitation without the use of reagents.

Continuous Blow-down.—Whatever method of purification is employed, all the salts carried into the boiler by the feed-water become concentrated in it. In general some calcium carbonate remains in solution in the water, and when the concentration produced by evaporation becomes sufficiently high it is deposited on the walls of the boiler or in the tubes forming incrustation, which is harder the more slowly the deposit is made. In boilers generating steam very rapidly the deposits are also formed rapidly, and may accumulate in the tubes notwithstanding the violence of the circulation. The usual remedy is periodic blowing-off from the lowest point in the boiler and, to be effective, a large quantity of water must be blown off at each operation, even though this should not form a large proportion of the boiler contents. The continuous blow-down allows the calories to be saved by passing the blow-down water through a feed-water heater, the mud being deposited in a trap during the process, together with the salts that had been retained in solution owing to the high temperature of the liquid. The only loss occurs in the actual removal of the mud and salts, which forms a relatively small quantity. The blow-down water freed from the impurities is then returned to the boiler. This prevents the concentration of the soluble salts to an extent at which they would constitute a danger.

The process of continuous blowing-down permits the contents of the boiler to be renewed frequently; it eliminates mud before it has time to accumulate, and at the same time allows the use of soda for the reduction of the calcareous bicarbonates. The feed-water, therefore, contains sodium carbonate and bicarbonate; the latter is decomposed in the boiler into carbonate, and the carbonate in its turn is dissociated in the presence of water with a reversible condition of equilibrium in functions of the initial concentration and the temperature, thus:—

$$CO_3Na_2 + H_2O = 2\,NaOH + CO_2$$

hydrolysis giving more caustic soda the higher the temperature. With continuous blowing-down the water containing caustic soda and carbonate of soda is used to purify the make-up feed, the caustic soda reacting more rapidly on the calcium bicarbonate than would calcium oxide. It is of great importance, therefore, to combine purification by soda with the continuous blowing-down process.

The author describes the Kestner continuous blow-down apparatus, consisting of a steam separator, a central reservoir receiving the blow-down liquid, and an annular chamber surrounding this reservoir, from which it receives heat, and into which the purified blow-down water is decanted. The steam passes into a reheater in which it heats the feed. The heated feed mixes with the blow-down as it leaves the central chamber and then passes to the annular chamber in which precipitation and settlement take place. Soda is added through a water-meter in proportion to the make-up feed. Valves are provided for separating the mud.

Central Stations Using Distilled Water.—The distilled water of industrial appliances differs greatly from that of the laboratory. Owing to the rate of evaporation particles of water containing salts are carried over, so that the distilled water contains numerous soluble salts in small, but by no means negligible quantity, and in boilers using distilled water it becomes in time a fairly concentrated liquor. Boilers working with distilled water, therefore, require to be blown-down occasionally, but it is not necessary to remove a large amount of liquid, the amount being usually only one or two per cent.; the saline solution is replaced by distilled water. Even when an evaporator is used the continuous blowing-down method can be adopted, and this in conjunction with degassing enables a complete closed water circuit to be arranged in a central station using distilled water.

Corrosion and its Causes.—Where distilled water is used there can be no doubt as to the cause. Oxidation of the plates can only be produced by oxygen dissolved in the feed-water and set free in the boiler, and the effect is greater with intermittent working. The author discusses the theories of corrosion, and points out the need for degassing purified water also, and he explains that the critical concentration, at which maximum corrosion by salts is effected, must be exceeded after a few hours' work in ordinary boilers. The air dissolved in water contains roughly 33 per cent. of oxygen.

Degassing.—The elimination of the oxygen dissolved in water may be effected either by physical or by chemical methods, or by both. Of the former the principal methods are: Agitation of the water, the action of temperature, and the action of vacuum; these may be used separately or, in the majority of cases, in combination. Of chemical methods, the only one that is important is the action of highly oxidisable iron which absorbs the oxygen from the feed-water. As the result of much experiment the author has found that for this purpose manganese is a catalytic agent of great importance, and a suitable manganese cast-iron has been found.

When an iron degasser that had become completely rusted was left at rest, it was found after a day to have undergone a change, and from red rust to have become greenish-black, due to reduction of ferric hydrate under the influence of the iron. This has led to the invention of the Puris degasser, which works on the regeneration principle; in one form by means of two vessels containing iron turnings, through which flow takes place alternately, and in the other form in a single vessel with filters at each end and a valve arrangement for permitting the direction of flow to be altered. The amount of iron used in the apparatus is stated to vary from 1 to 3 grammes per ton of water treated, and the amount so used corresponds to the weight of boiler-plate saved from destruction.

The suggestion of a water circuit closed from atmospheric contact is discussed, and the combination of a degasser with such a system is recommended as a means for preventing any harm due to access of oxygen from accidental causes.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New House-lighting Set.

A compact little house-lighting set has lately been put on the market by the Electrical Construction Co., Ltd., Wolverhampton. It comprises a Villiers 2½-h.p., two-stroke engine with flywheel magneto, of the type largely used on motor cycles, coupled to a two-pole, shunt-wound dynamo giving ¼ kW at 25-30 volts continuously. Comprised with the set is a battery of 60 amp.-hours capacity at 25 volts, sufficient to run ten lamps for ten hours or five lamps for twenty hours, so that in a small country house it is only necessary to run the engine to charge the battery about twice a week.

An Earthing Clip.

A neat earthing clip has been brought to our notice by Mr. M. Goldsmith, of 4, Florence Terrace, London, W. 6. It consists of a stout strip of tinned copper, perforated at intervals, and provided at one end with a U-shaped lug in which the earthing wire is laid; the wire passes under a triangular washer, and is gripped by a coppered bolt which passes through the strip, thus clamping the earth wire to

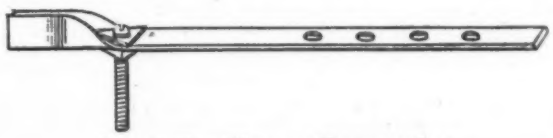

Fig. 1.—The Windman Earthing Clip.

the strip and the strip round a water-pipe simultaneously. The washer being triangular, with one corner projecting into the mouth of the trough or lug, cannot rotate when the bolt is being tightened up. The strip is made in various sizes and thicknesses by the Windman-Goldsmith Corporation, Perth Amboy, N.J., U.S.A., which is seeking patent protection. Mr. Goldsmith is the U.K. representative of the makers.

New Switch Plates.

We have received from The Isis Electrical Co., 57, Albert Road, Aston, Birmingham, two samples of some new switch plates which the firm is now turning out. These are very substantial articles of excellent finish and appearance. The firm states that it "believes these to be the only diamond die engine-turned switch plates made." They are engraved in parallel straight lines, which besides adding to the appearance also minimise the bad effects of scratches. Various metals and metal finishes are supplied.

Extra Voltage for Battery Charging.

Mr. N. D. Blagdon Phillips, A.M.I.E.E., of Dursley, Gloucestershire, writes:—

In order to obtain the extra voltage from a generator, for giving the "gassing" charge to a battery, without increasing the speed of the set, the arrangement shown in the diagram (fig. 2) may prove useful.

The windings A B and C D represent the two field coils of a shunt machine, and S a single pole switch, connected to tappings of the field coils at E and F.

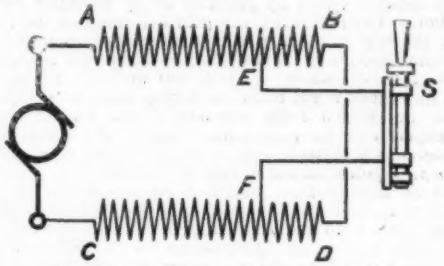

Fig. 2.—A Voltage Raising Device.

For normal running the switch is kept closed, thus only the portions A E and C F of the coils are effective; for the gassing charge, then, the switch is opened, and the additional turns E B and F D are brought into use to get the higher voltage.

A New Switch Plug.

Messrs. Albert Lee & Co., Ltd., 8 and 9, New Zealand Avenue, E.C. 1, have sent us for inspection a 10-amp. wall socket and two-pin plug insulated with a fire-proof material known as "Fiprallee." From exhaustive mechanical and electrical tests carried out at the National Physical Laboratory it would appear that, in many respects, the material is superior to porcelain; it is non-hygroscopic, acid-proof, and of high dielectric value. The wall socket and plug are of very solid construction, and all metal parts are effectively protected. The pins fit into bushes screwed into the terminals, which are moulded in the material, making a very safe contact. The construction of these plugs and sockets is such that they can carry 25 A without any risk.

LEGAL.

Claim for Lighting Set.

At Bishop's Stortford County Court, Mr. Philip H. Bedser sued Mr. Ernest E. Smith, proprietor of the local kinema, for the balance due for the supply and erection of a twin-cylinder lighting set—£76 19s. 2d. A counter-claim for £100 for expenses incurred in putting the engine in order was entered by the defendant.

It was stated by Mr. Smith's counsel that in 1918 his client contemplated substituting electric for gas lighting in his hall, and Mr. Bedser, after negotiations, offered to supply an engine in first-class running order, with a generator and battery, at a cost of £580. The set was installed, and from the beginning had been a source of trouble owing to frequent breakdowns. The engine was defective, and after numerous repairs it broke down altogether. Mr. Bedser denied that the engine was defective, stating that he left it working satisfactorily. He admitted that the engine possibly could go wrong without this being due to incompetence in management.

The case was adjourned finally until March 14th.

Breach of Apprenticeship Deed.

At Gloucester County Court on February 28th, Lionel Cadogan Mitchell, electrical engineer, claimed £10 damages from Samuel Johnson and his son, Henry Johnson, for an alleged breach of agreement relating to the apprenticeship of the younger defendant.

Plaintiff stated that this defendant left his employ five months before the expiration of the term of apprenticeship, and commenced work elsewhere. In addition to the claim, plaintiff sought an injunction to restrain Henry Johnson from committing a breach of the deed by being engaged with any other person in business as an electrical engineer within the City of Gloucester or a radius of six miles from the city, for five years after the expiration of the terms of the deed. The younger defendant, in his evidence, said that he became apprenticed to plaintiff when 16½ years of age. He was called up for the Army, and joined the Royal Engineers. Upon his demobilisation, witness said, he did not agree to continue his apprenticeship, as he considered himself worth a journeyman's rate. Defendants' counsel argued that the agreement was cancelled by virtue of the younger defendant's military service. Upon the other hand, counsel for plaintiff claimed that the deed was not cancelled thereby.

His Honour Judge Alan Macpherson held that plaintiff had failed on both claims; he decided that the agreement was brought to a conclusion by Henry Johnson's joining the Army, and in the absence of a definite agreement to revive it the deed was dead. The restrictions regarding employment after apprenticeship were held by the judge to be contrary to public policy. Judgment, with costs, was entered for defendants.

Pretoria and Municipal Employes.

A serious position was created in consequence of the judgment in the case of the Transvaal Property & Investment Co. v. the Pretoria Municipality. The applicants, the owners and lessees of certain premises, requested the installation of electric light. It appeared that during the construction of the premises a dispute arose between the company and the Joint Board of Master Builders and the Builders' Industrial Union, and as a result the work on the premises was "blacklisted." The municipal employés would do no work there in the way of inspection or connection until the disputes had been settled. In the opinion of the manager of the electric supply department, the employment of persons other than municipal employés would cause a strike, with the result that all the electrical services of the Council, including tramways and lighting, would be stopped.

Mr. Justice Mason, in the course of his judgment, said the obligation on the municipality arose under the statute, and the rights of the inhabitants were governed by the statutory provision and legal constitution of the Municipal Corporation. The duty of the Court was to enforce the legal right of the individual against everyone, however powerful or highly placed, and it had no discretion to refuse such an application as the present one for the enforcement of a plain legal right because difficulties might arise in the carrying out of its judgment. The Court was entitled to rely on citizens, whether in the service of the municipality or not, fulfilling their declared and positive legal obligations. There would, therefore, be an order directing the respondent to connect or cause to be connected the electric light from the municipal supply to the applicants' premises within ten days, and thereafter to supply, subject to such charges and upon such conditions as had been lawfully fixed and subject to the installation being in accordance with the requirements. The municipality must pay the costs of the application.—*Cape Times.*

A Western Ireland Electricity Company.

An application was made in the High Court of Ireland, before Mr. Justice Powell, by the Ballinrobe Electric & Woollen Company for power to enlarge its sphere of operations. The company, it was explained by counsel, was formed to supply electric light to towns in Co. Mayo, and by special resolutions the shareholders now desired to engage in the manufacture of woollens and textiles.

His Lordship said he would reserve his decision until an affidavit had been filed showing whether any creditors objected.

Thefts of Electricity.

On March 7th, the Clacton U.D.C. prosecuted Charles R. Small, an engineer, for having diverted electricity from a meter circuit. The clerk to the Council stated that defendant's house was supplied with electricity through two separate meters, one for lighting and the other for heating. Upon an examination of the meters it was found that although the lighting meter appeared to be in order the heating meter had been tampered with. The connecting wires had been stripped and crossed, thus short-circuiting the meter installation. Defendant admitted twisting the wires, but stated that he did not do it wilfully, but through ignorance. It was said that the loss sustained by the electricity department was probably under £2. After deliberation the magistrates fined defendant £5.

Another case of this nature was brought before the Stipendiary Magistrate at Stoke-on-Trent on March 11th. The Corporation prosecuted Alfred Phillips, of Hanley, for fraudulently preventing an electricity meter from registering the quantity of electricity supplied by the Corporation; abstracting electricity "the property of the Corporation"; and causing to be laid certain wires or conductors to communicate with the Corporation's mains without the consent of the Corporation. The defendant's mother was also summoned on these three charges, but the case against her was dismissed on payment of court costs. Defendant pleaded guilty to all the charges. The Corporation's counsel stated that upon examining the defendant's premises, an inspector of mains found that wires had been taken from between the point of entry and the meter. A lamp had been connected to these wires. The ordinary lighting energy was being registered by the meter. Upon a second visit the inspector found that the lamp and its accessories had been removed, and a motor had taken its place. Defendant then denied knowledge of this, but it was evident that the defendant had guilty knowledge, as the connections made called for at least a reasonable knowledge of electrical matters. Defendant's counsel said his client desired to be frank. He was not an electrician, but when he found insufficient lighting in the cellar he decided to fix another lamp. He did this, but was not aware that the electricity being used was not passing through the meter. Later he

found this circumstance out, but continued to run the light, and he had also connected a motor for a little time.

The magistrate regarded the case as a serious one, and imposed a fine of £10 and costs, making a total of £16 2s.

Keen v. Slocock.

In the Mayor's and City of London Court last week, before Mr. Registrar Wild, a claim was made by Herbert Edward Keen, trading as H. E. Keen, electrical engineer, Great Smith Street, Westminster, against Mr. H. L. Slocock, solicitor, Old Broad Street, E.C., for £5 for the hire of a motor lorry on May 26th. According to the plaintiff's case the defendant required certain electrical fittings to be conveyed to a cottage at Marlow that he was fitting up with electricity, and it was arranged that the material should be sent by road by motor lorry. Accordingly a Studebaker motor lorry was hired at a price of £5, and the goods were conveyed to Marlow. The installation at the cottage had been carried out by the plaintiff, and there had been some compromise as to the price paid for the work, but the hire of the motor lorry was not included, and had not been paid. Mrs. Keen was called, and proved the arrangement being made for the hire of the lorry to convey the electrical material to Marlow, and that the amount for the hire was still due. The defendant said that the plaintiff had undertaken to carry out the electrical installation in question in fourteen days provided the material was delivered at the place at once. The railway people could not deliver, and as it was essential to have the material there at once he consented to the lorry taking it down. Had the electrical work been done in fourteen days he would have paid for the hire, but the work took seven weeks. The installation too was faulty, and the matter had been referred to a firm of contractors, the whole matter as he understood being then settled. Now the question of the lorry had been brought up. The Registrar said the question of faulty installation had nothing to do with the present claim. If the defendant thought he had any grounds for complaint in respect of it he should have raised a counter-claim. There had been an agreement to pay £5 for particular work which had been done. There was no counter-claim, and the plaintiff was entitled to judgment, which was entered accordingly with costs.

Workmen's Compensation Case.

A case under the Workmen's Compensation Act was heard at Marylebone County Court, on Monday, before Judge Sir Walworth H. Roberts, when John Childs, an electrical wireman, claimed compensation against Mr. Ford, a turf accountant, of Notting Hill, for injuries received on November 8th last.

The evidence of applicant was that he was engaged to do some electric wiring in a house at 23, Pembridge Square, and on the date in question, while at his work on a step ladder testing and repairing electric wires, the ladder slipped, and he fell, fracturing his left arm and dislocating his shoulder. Applicant was 60 years of age, and had been employed by the respondent at 1s. 9d. per hour, being subject to an hour's notice. He worked from eight o'clock in the morning till five in the evening, and one o'clock on Saturdays, his weekly earnings being £3 18s. 6d. Applicant only claimed 35s. for the period of his incapacity, as he had been working with the respondent only for about 15 days when the accident occurred. A man named Skimmings had been employed under him, but to reduce expenses his employer dispensed with Skimmings's services and engaged a lad in his place. During the previous twelve months applicant had been receiving an average weekly wage of £4.

The Judge said that no answer to the claim having been filed a *prima facie* case had been made out. He found in favour of the applicant, allowing him £1 per week, with 75 per cent. (additional war allowance), altogether 35s. per week.

Quain v. Spink.—Correction.

We regret to find that an error occurred in the report of this case appearing in the Electrical Review for March 4th. The defendant Spink had not entered a counter-claim for the balance of £15 wages, and judgment was not given for him for that amount. Our reporter based his inaccurate reference to this point on a statement appearing in defendant's affidavit filed in court.

Freemasonry.—The secretary of the Kelvin Lodge wishes to remind the members that owing to the Easter Holidays the next regular meeting will be held on Thursday, March 31st, and not on Friday, March 25th (Good Friday).

The Albert Medal.—At a meeting of the Council of the Royal Society of Arts, held on Monday, the Chairman, Mr. Alan A. Campbell Swinton, F.R.S., presented the Albert Medal of the Society to Prof. A. A. Michelson, For. Mem. R.S., awarded to him in 1920 for his optical inventions which have rendered possible the reproduction of accurate metric standards and have provided the means of carrying out measurements with a minute precision hitherto unobtainable.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR FEBRUARY, 1921.

A fall occurred during February in the values of goods under the three heads—exports, imports, and re-exports. This may have been due, in part, to the decline in certain prices, although, perhaps, this is of too recent occurrence to have made its effect felt yet. The reduction in the export figure amounted to £223,703, or 12 per cent.; imports fell by over 20 per cent.; and re-exports were reduced in value to the extent of 15 per cent. In the case of the exports the reduction was evenly distributed among the separate items, but there were big falls in the value of imported electrical machinery and goods (unenumerated). Increases occurred in the export of submarine cables, telegraph and telephone instruments, and glow lamps, in the import of insulated wire, glow lamps, and meters, and in the re-export of glow lamps and carbons.

Values of Electrical Exports and Imports for February, 1921.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£220,244	£92,904	£15,629
Insulated wire	319,195	13,874	—
Glow lamps	45,775	21,653	8,329
Arc lamps and parts	2,421	4,432	20
Batteries	73,950	11,859	31
Meters	30,953	26,696	4,080
Carbons	12,151	10,319	917
Electrical machinery:—			
Railway and tramway motors ...	12,919	—	—
Other motors and generators ...	235,633	—	—
Electrical machinery (unenumerated)	143,974	64,062	3,187
Switchboards (not telegraph or telephone)	9,506	952	40
Telegraph and telephone cable and material:—			
Telegraph and telephone wire and cable (not submarine)	152,151	9,669	114
Submarine telegraph and telephone cable	106,752	—	—
Telegraph and telephone instruments and apparatus	150,703	25,877	882
Totals... ...	£1,516,327	£281,297	£33,229

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Wiring in Ferro-concrete Factories.

The letters in your issues of February 25th and March 4th are of interest, especially the letter signed "J. K. G.," as I have had similar experience where the wires have resisted the flames although the copper sheathing showed signs of being heated to nearly melting point. For years past I have used Stannos wires buried in concrete buildings, and have yet to learn of a failure.

In 1912 I buried several lengths of Stannos wire in various kinds of cements and plasters, on both d.c. and a.c. circuits, and after three years I cut away the cement and carefully examined the sheathing with a magnifying glass, and in no case was there any sign of destruction. The only alteration observable was in some cases a slight discoloration of the outer tinned surface, but in the case of the wire covered by Portland cement, even this was absent, and the surface came out as clean as on the day on which it was put in.

Before 1912 and since I have laid wires in concrete, ordinary plaster, special plasters, and various floor compositions, and, as before stated, with complete success. There are a number of buildings constructed which will not permit ordinary steel tubes beneath the plaster without cutting into the base; this applies more particularly to those buildings where patent hard-surface plaster is used, very often not exceeding a quarter of an inch in thickness, and I know of no system better suited for such a building than the Stannos wire. It would be interesting to know of other contractors' experience in this matter, as the attempt to use steel conduits in buildings of this character not only brings about mechanical and costly difficulties, but in very many cases leads to condensation troubles, which are entirely absent when sheathed wires are used.

Having used Stannos wire continuously since 1909 for wiring many thousands of lights on the ordinary 2-wire system, and also with the outer sheathing as the return negative, and having done this without trouble of any kind, I have no hesitation in saying that it possesses more advantages than any of the other known methods in use at the present time.

I attribute this to the resisting properties of tinned copper, together with the fact that once the wire is placed in position it will be found as I have found it, the same after ten years' use, namely, free from movement of any kind.

E

Owing to the protective qualities of Portland cement, I have for many years past, when burying wires under soft plaster, had them covered with Portland cement, which acts not only as a preservative, but is practically nail-proof.

Rawlings Bros., Ltd.,
W. R. Rawlings,
Managing Director.

London.
March 11th, 1921.

Your correspondent "Inquirer" says "C.T.S. cables strike him as being rather too unprotected for general use, although, of course, ideal for some classes of work."

As an instance of "damning with faint praise" this sentence will take some beating. But can "Inquirer" give any instances of this inadequacy of protection? We will wager not! C.T.S. has reached its present state of popularity largely through its ability to protect.

We can, however, tell him of at least one ferro-concrete job of 250 houses in Weaverham, Cheshire, where C.T.S. is not considered "rather too unprotected."

We venture to suggest to you, Sirs, that when you receive letters for publication containing paragraphs airily condemning something or someone, under a *nom de plume*, you should, in fairness, do one of three things:—

1. Get proof of the writer's assertions.
2. Make him publish his name and address.
3. Submit the letter to the firm likely to be affected, to enable them to answer the libellous statements on the same page as the letter containing them.

St. Helens Cable & Rubber Co., Ltd.,
J. H. C. Brooking.

Warrington.
March 14th, 1921.

Domestic Supply from 500-volt Generators.

Replying to "Inquirer," I would point out that his problem has been solved by Dettmar in the way mentioned by him, *i.e.*, fixing another pair of auxiliary brushes between the existing brushes. As this brush will short-circuit two segments whenever it bridges the insulation between them, it is necessary that the coil thus short-circuited should be moving in a weak field. Dettmar arranged this by leaving a gap in the middle of the pole.

With "Inquirer's" present machines the above would not be practicable, and therefore if he has not a battery it will be necessary to use the static balancer system.

At least two rings will be required on the revolving part; and a connection must be made to two points in the winding or two segments.

A choking coil must be connected to the two rings. For 120 volts a 24 per cent. tap would be taken. For 150 volts a 30 per cent. tap would be made. For 250 volts the wire would be taken from the middle point of the choking coil.

These static balancers are sold by firms in this country.

If the out-of-balance current for the 120-volt tap was limited to 50 amps., the output of the balancer would be 6 kW. To get a rough idea of the cost it would be necessary to know the r.p.m. of the generators, the number of poles, and the lower pressure and the maximum out-of-balance current.

There will be a magnetising current in the choke of frequency r.p.m. × number of poles/120 cycles per second.

The size of a static balancer is about one-half the size of a transformer of the same volt-amp. capacity.

If "Inquirer" cares to get in touch with me directly, I shall be pleased to give him further information. I send my name and address herewith.

T. W. R.

March 14th, 1921.

In reply to "Inquirer" (March 4th) as to the practicability of obtaining a reduced pressure for domestic purposes by fitting another set of brushes between the existing brushes, this is extremely impracticable, in fact, impossible. Certainly there is a point between the existing brushes where this desired low pressure would evidence itself on a voltmeter, but it cannot be utilised owing to the fact that the pressure between adjacent commutator segments at this point would be very considerable, and as these sections would be short-circuited as they came under the brushes, enormous local currents would be set up, resulting in terrific sparking and flashing over, with the almost certain destruction of the insulation of the machine.

So far as I can judge, the only disadvantage of conversion to the 3-wire system at 250 volts between outers and neutral is the expense involved in reconstruction of the generating plant and rewiring for domestic supply.

The alternative to conversion to the 3-wire system would be the installation of a motor-generator, the motor being wound for 500 volts, and the generator to give the desired low pressure for domestic work.

This method, of course, would not be nearly so expensive as the entire reconstruction of the system to a 3-wire supply.

K.

March 7th, 1921.

Lead-covered Wiring and Payment According to Ability.

In your current issue, it is interesting to read communications from two readers, "Bourgeois" and "Regular Reader"; the former inquires, the latter replies. Quite a coincidence.

To "Bourgeois," I would say that, given a lead-covered V.I.R. cable or wire of C.M.A. quality, with the standardised accessories, bonding clamps, earthing clips, &c., used in connection therewith, he has, so far as the goods are concerned, all that can be desired; in fact, properly installed under proper supervision, the system bids fair to rank as the ideal system for electrical installations for lighting.

I, for one, can positively assert that it is not the particular system of wiring which makes for an efficient installation, passing all tests required by the supply authority, that is, examination of the work first, then an insulation test, to earth and between, wattage of the circuits, and the nature of the "earth," but rather is it the quality of the labour handling the goods. This latter factor in installation work has become a positive danger, and is a source of considerable anxiety to any installation engineer upon whom the full responsibility falls for scamped work under floors, in roofs, and, in fact, anywhere where the "handywork" of the "handyman electrician" is doomed to be concealed from view.

When you consider the extent to which the once specialised trade of "electric wiring" has drifted into the hands of plumbers, ironmongers, decorators, &c., all self-styled electrical and sanitary engineers, all ready at a push to enlist in their services men whose knowledge of the trade, in training and experience, is limited to the screwing of a pipe and tugging wires through, the majority shielded and protected against "payment on merit," or, as "Regular Reader" advocates, on ability, by their unions, is it to be wondered at that inquiries stop at inquiries, and that a tender has not been received from "So and So" for such and such a contract?

I fear, Sir, in common with others whose ambition is to revive the trade with a sound job with a sound guarantee, the remedy of registration with the E.C.A. would be of little avail; would not the registration of the "man" be better? Is it not a trained man's due to enjoy the confidence of, and be paid better by, his employer, than some of the imitations who at the present time contaminate the industry, and yet are considered to be on the same footing and receive the same rate, simply because?—well, I'll leave the rest for a more able explanation.

I do not know, but I am very much inclined to think, that your "Regular Reader" would support the contention: "Survival of the Fittest," and I wish him every success, and conclude,

Engineer Contractor.

March 14th, 1921.

[Our correspondent appears implicitly to support the policy of registration of contractors by his remarks about "self-styled electrical and sanitary engineers"; we agree that the wireman also should give proofs of his competence, but ought not that qualification to be guaranteed by his trade union? We may add that "Survival of the Fittest" by no means necessarily connotes the survival of the best.—Eds. Elec. Rev.]

Payment According to Ability.

Your correspondent, "A Regular Reader," seems to have left out of his consideration altogether the human side, also the fact that quality counts as well as quantity. I should like to ask him what is to become of the man (possibly married and a father) who fails to pass the work test? I well remember once failing to pass a test, but I was put on a course of instruction, and came second out of forty-two in the final exam., and highest aggregate for thirteen exams., proving from my own experience that the man who fails to pass a test is not necessarily a failure. Therefore I contend that before any concern institutes a system of work tests, it should be prepared to instruct those who fail, with a view to a second and possibly a third chance of passing. The suggestion that one-third of the average engineering factory's employés (fitters and turners) are not worth their keep, and further, that the other two-thirds adjust their output to the level of the lowest, is absurd. Everyone admits that there are wasters, but one-third is a gross exaggeration, and if all adjusted their output to the same level it would be impossible for anyone to pick out the waster or to show that there were wasters at all. Though it may sometimes be so, it is not an invariable rule that the man with fifteen years' experience besides his apprenticeship is worth more than the man just out of his time. At thirty-six a man has lost some of the youthful vigour and enthusiasm he possessed at twenty-one. Further, he is not so responsive to new ideas. The young man nearly always has the advantage in technical knowledge. I once desired a simple explanation of "power factor." The explanations given in various books I got hold of being rather beyond me at that time, I asked my workmates. The older ones seemed to have no idea; the younger ones had ideas more or less vague, but were unable to express them, and finally I got my explanation from a fellow apprentice, a lad of eighteen. I will give a little of my experience, to compare with your correspondent's. I have met these two to one men. I am a wireman, and on one well-remembered occasion worked alongside of another man who wired 41 lights to my

22, precisely identical jobs. The result was that I got the sack, the contractor telling me he had no use for drawing-room wiremen, which I took as a compliment. I never regretted it, and I never lost by it. I take a pride in my work, and contend that it is bad generally to sacrifice quality to quantity. Later I worked alongside of the same man for another contractor, but this time he got the sack for scamped work and making a mess of some two-way wiring. Who was the better man then? He was the elder. As to the causes of low production, these are many and complex. Fear of unemployment is one, lack of direct interest in the undertaking is another, uncongenial and unhealthy surroundings is another, monotonous repetition work is another. The fact that employers do not always take advantage of new and improved machinery is another, and so we might go on. For some the masters are to blame, for some the men.

In conclusion, I would say to "A Regular Reader" that fifteen years' extra experience on a particular job very often makes a man a more experienced dodger.

Another Regular Reader.

March 14th, 1921.

Electric Radiators.

Some time ago a discussion took place in the ELECTRICAL REVIEW regarding the efficiency of radiators. It was then contended that radiators which allowed air to pass freely through were less efficient than radiators arranged so that air could not pass through. The first type gives off its heat as hot air, which promptly goes to the ceiling, whereas the second type gives radiant heat, which warms the room more effectively.

For some time past I have tried a radiator, for office heating, in which the heating coils are held in horizontal grooves, so that no air can circulate through them. My experience is that a 2-kW radiator of this type is more efficient, for actual heating purposes, than a 3-kW one in which the wires are arranged so that the air circulates through them freely.

These facts are slowly becoming known amongst radiator makers, but there are still large numbers of the bad and inefficient type being sold. These do a great deal to bring electrical radiators into disrepute.

To get the best results out of radiators the wires should be run at a bright red heat. Apparently this can be managed satisfactorily with modern high quality resistance wires.

Radiator.

March 10th, 1921.

Mains Records.

I desire to obtain information regarding up-to-date methods of keeping mains records, and wish to know whether any of your readers could put me on the track of obtaining it. I am chiefly interested in the upkeep of records for overhead transmission, h.t. and l.t. networks, where numerous extensions and alterations are constantly being carried out. Any information on the subject would be much appreciated.

Colonial Inquirer.

March 14th, 1921.

Gas-heated Appliances.

I venture to draw your attention to the large number of electrical manufacturers in this country who continue to use gas-heated appliances in the manufacture of electrical parts. Strange to say, even small articles like soldering irons are in the majority of cases gas-heated.

I suggest that this is a field where that very useful body, the E.D.A., will find wide scope. Extremely useful missionary work might be done, even among its own members.

X.

March 8th, 1921.

BUSINESS NOTES.

Bankruptcy Proceedings.—DAVID SUCHOSTAWER, 1, First Avenue, Acton, Middlesex, engineer.—The adjourned public examination of this debtor was held recently at Brentford. It was reported that the debtor was a Russian subject who came to England in 1907. He commenced business, and stated that he had invented a machine which would transform the propulsion powers of motor-cars. Debtor alleged that he had assigned a certain patent to a company. This patent was a device to collect the mechanical and electrical power and get them to act simultaneously. Debtor stated that he had spent about £500 on machinery and experiments. The examination was adjourned to be closed.

JOHN WILLIAM GLADWIN, electrical engineer, 81, Burcot Road, and 1A, Meadbrook Park Road, Sheffield.—The following are creditors herein:—

Ashton, T. A., Ltd.	£12	Hattersley & Davidson	£32
British Insulated and Helsby Cables, Ltd.	29	Housley, George	21
Carron Co.	11	Mechanical and Electrical Engineering Co.	48
Crammer & Cheshire	17	Oliver Typewriter Co., Ltd.	50
Derbyshire, Alfred	50	Pashley, Arthur	106
Drake & Gorham	36	Pass, Benjamin	20
Gladwin, Annie	48	Siemens Bros. & Co., Ltd.	16
Hall, Bernard	150	Sheffield Electric Supply Dept.	12
Hallamshire Electric Co., Ltd.	79	Smith & Sons	16

ALBERT EDWARD DICKINSON, trading as the Crown Electrical Co., 157, Hunslet Road, Leeds. Electrical engineer and contractor.—The public examination of this debtor was held on March 8th, at the County Court House, Albion Place, Leeds. The statement of affairs showed liabilities £514, against assets estimated to realise £79, leaving a deficiency of £435. Debtor attributed his position to want of capital and bad trade. He stated that when his petition was filed, the sheriff was in possession under an execution for £39. Debtor commenced business in partnership with another in April, 1919. He possessed stock worth £30, while his partner found about £285. The business was not a success, and in May, 1920, the partner went out of the business, debtor agreeing to repay the amount of his capital when he was able to do so, but none of it had been repaid. He had kept books of account, but it was stated that they were not properly entered up. He became aware of his position in May, 1920. The examination was closed.

ALBERT LORD, electrical contractor, 33, Westgate, Burnley.—This public examination took place at Burnley on March 10th. The liabilities were £977, and assets £52. The cause of failure alleged by debtor was "heavy household expenses." Debtor said he did not think the profits on the business were ever equal to his household expenses. He commenced without capital, and did small jobs at first, but later took a £565 contract, from which he allotted £250 to a Manchester firm for materials. He lost money on that work. That was one of the reasons for his insolvency. He denied selling off his stock quickly just prior to filing his petition. The examination was closed.

Private Meeting.—A. JAY & Co., electrical engineers, 48, Fenchurch Street, London, E.C.—A meeting of the creditors of the above was held recently, at the offices of Messrs. Poppleton, Appleby & Hawkins, 4, Charterhouse Square, E.C., when a statement of affairs was presented which showed liabilities of £736 due to trade creditors. The assets were estimated to produce £605, less £70 for preferential claims, leaving net assets of £535, or a deficiency of £201.

Mr. C. Poppleton reported that the debtor commenced business in Fenchurch Street in May of last year, with a capital of £800, which represented his savings. He expended £200 in fitting and decorating the shop. The shop takings had only averaged some £46 a month, while the rent had been £35 a month, but through having premises in Fenchurch Street a quantity of repair work had been obtained, and the turnover had been in the neighbourhood of £1,000. Since the commencement, £217 had been spent in wages. The deficiency in the statement of affairs was practically accounted for by the writing down of the assets, and the present position was attributed to the money expended in establishing the business. It was pointed out that since the commencement the takings had always been progressive.

After discussing the position the creditors decided that a deed of assignment should be executed, with Mr. E. H. Hawkins as trustee, and that the debtor should be allowed to carry on the business and a committee was appointed, consisting of representatives of the Ediswan Electric Co., the International Electric Co., and the Ever-Ready Co.

The following are creditors:—

Watshams	£15	Falk, Stadelmann & Co.	£43
Welco, Ltd	12	Siemens Bros., Ltd.	52
Edison & Swan & Co.	210	Wardle Engineering Co., Ltd.	13
International Electric Co., Ltd.	88	Asnew Lamp Co.	19
Helium Lamp Co.	13	British Thomson-Houston Co., Ltd.	130
Evered & Co., Ltd.	13	Ever-Ready Co., Ltd.	40
Metropolitan-Vickers, Ltd.	50		

Dissolution of Partnership.—LUCASSE ELECTRIC CO., electrical engineers, 31A, Stoney Stanton Road, Coventry.—Mr. A. Eccleston, Mr. N. H. Copson, and Mr. C. W. Fairfax have dissolved partnership. Debts will be attended to by Mr. C. W. Fairfax, who will continue the business in his own name at 44, Sackville Street, Coventry.

Trade Announcements.—MESSRS. W. D. CLOUGH, LTD., have recently opened premises at 185, Fordneuk Street, Bridgeton, Glasgow, equipped with plant for the business of automobile, electrical and mechanical engineers; electrical repair, re-winding, contracting and wiring work will be undertaken, and trade literature is wanted.

Mr. J. S. Dyas, of 68, Dawson Street, Dublin, has been appointed representative in Ireland for MESSRS. H. W. SMITH & CO. (1920), LTD.

As from March 21st the registered address of the TWISS ELECTRIC TRANSMISSION, LTD., will be 39, Victoria Street, Westminster, S.W. 1, larger offices having become necessary owing to increased business.

The London office of the HART MANUFACTURING CO. is now under the management of Mr. T. C. Meale, who has been with the company for the past 13 years.

ELECTRICAL UTILITIES, LTD., are vacating their Victoria Street offices, and all communications should be addressed to the works at 1-3, Shelgate Road, Battersea Rise, S.W. 11.

MR. E. MITCHELL (hand-made ornamental switchplates, &c.), has removed to larger premises at 412A, Great Horton Road, Bradford.

The Esperanto Lamp Co. (managing director, Mr. F. L. Strawson) has been formed to carry on the lamp business of the London Factors and Agents, Ltd. The office address will be 38 and 39, Parliament Street, London, S.W. 1. The general business of the London Factors and Agents, Ltd., is unaffected by the change.

Company Liquidations. — Stols Electrophone Co. (1914), Ltd.—A petition for the winding up has been presented to the High Court by Messrs. T. B. Browne, Ltd., of 163, Queen Victoria Street, E.C., and will be heard in London on March 22nd.

Simplex Construction Co., Ltd.—A petition for the winding up of this company has been presented by Mr. J. Murray, of 11, Suffolk Street, Pall Mall, S.W., and will be heard by the High Court on March 22nd.

Electrical Industries, Ltd.—The first meetings of the creditors and shareholders were held at the Carey Street Offices of the Board of Trade on March 9th, when Mr. Warley, Official Receiver, reported that after satisfying the preferential creditors and debenture-holder, there would only be a very small margin for distribution among the unsecured creditors. A resolution was passed for the liquidation to be left in the hands of the Official Receiver.

Catalogues and Lists.—Ironclad Switchgear Co., Ltd., Monton Lane, Eccles, Lancashire.—An illustrated and priced booklet of various types of ironclad switch and fuse gear.

Messrs. Baker & Hyman, 11 and 13, Portland Crescent, Leeds.—Four illustrated and priced leaflets dealing respectively with an automatic scissors-type arc lamp, circular rheostats, scissors-type miniature arc-lamp outfit, and standard-type rheostats.

The Walsall Hardware Manufacturing Co., Ltd., Ablewell Street, Walsall.—"The Grip"—a little magazine dealing with points in connection with grip conduits and fittings.

Messrs. R. B. Hand & Co., Ltd., 63, High Holborn, W.C.1.—A well-illustrated and detailed catalogue of portable electric machinery (flexible shaft drives) manufactured by the R. G. Haskins Co., of Chicago, for which Messrs. Hand are sole agents in the British Isles.

The British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C. 4.—Price-list No. 10,550—B (Section I), giving illustrated descriptions of applications of "Eye-Rest" indirect lighting.

Messrs. H. C. Slingsby, 142, 144, and 146, Old Street, E.C.—List No. 149, illustrating trucks, ladders, barrows, &c., and giving full details.

Messrs. Thompson & Co., 48, Watling Street, E.C. 4.—Prospectus No. 283 of the Société Genevoise d'Instruments de Physique, illustrating and describing "Rex" single-phase meters.

The Falkirk Iron Co., Ltd., Falkirk.—A leaflet, illustrated in colour, describing the "Falco" electric iron; priced.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Leaflet No. X 2,389, illustrating and describing "Witton-M.L." circuit-breakers of various types. Fully priced and detailed.

Messrs. E. P. Allam & Co., 107 — 109, Gray's Inn Road, London, W.C. 1.—March stock-list of electric motors for sale or hire.

Messrs. Vickers-Petters, Ltd., Ipswich Works, Ipswich.—A well-illustrated catalogue (50 pp.) of Vickers-Petters semi-Diesel crude-oil stationary and marine engines, with numerous views of actual installations and illustrations of erecting shops, &c. Full details of the engines are given, and a description of a new electric starting device.

Messrs. Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, E.C. 4.—"Liquid Fuel Burning for Marine and Land Boilers," an interesting brochure profusely illustrated by views of oil-firing installations. The advantages of the system are set forth as well as full descriptions of applications of the plant to various types of boilers. Also a list of the principal ports at which fuel oil may be obtained.

Electrical Trade in South Africa.—According to the *British and South African Export Gazette*, the installation of electric tramways is under consideration in many centres in South Africa, and the work might be considerably hastened by the enterprising effort and advice of local firms holding agencies for British manufacturers of the plant required. Complete electric lighting plants, with a capacity ranging from 20 to 1,000 lamps, are being actively pushed with satisfactory results in all the East African markets. They include both British and American types.

Proposed British Fair at Bukarest.—The Rumanian Press Bureau publishes the following statement:—"The British Government has notified the Rumanian Government of its desire to hold a fair on a large scale at Bukarest, at which goods from Great Britain and the British Dominions would be exhibited, the object being to supply Rumania and the other States in the south of Europe with such goods. Negotiations on the subject between the two Governments will begin shortly."—*Reuter's Trade Service* (Bukarest).

Social Events.—About 120 members of the staff of the Osram-G.E.C. Lamp Works assembled at the Café Royal on the 11th inst., under the chairmanship of Mr. C. Wilson, managing director, the occasion being the revival of the annual staff dinner, and a very enjoyable evening was spent. The speeches were commendably brief and to the point; following the loyal toast, which was proposed by the chairman, Mr. W. F. Franks proposed "The Firm," and, in the absence of Mr. H. Hirst, Mr. White replied. The chairman also replied, remarking that during the war everyone had become slack, but in the last year or so, much improvement had been made; in future they would all have to work harder than they had ever worked in their lives before; if they relaxed their efforts they might go under, but he was sure that if every man did his best, they would have nothing to fear. Their aim was to find out what other people were doing, and then try to go one point better; the newly inaugurated research department had already done excellent work, but it was still young, and had a future before it. When it had had time to get into proper working stride it would prove of immense value to the whole of the G.E.C. undertakings. The rest of the evening was devoted to a programme of music and song (excellently arranged by Mr. F. Cole), Mr. Dion Lane's contributions being particularly appreciated. During the interval Mr. J. F. Jessop, in a few well-chosen words, proposed "The Chairman," the toast being drunk with musical honours, and after completing the musical programme, the company dispersed after having spent a most enjoyable evening.

The fourth social evening of the Ediswan Bristol Staff and their friends was held at the company's showrooms on the 2nd inst.

The annual staff dinner of Messrs. J. H. Holmes & Co., Newcastle-on-Tyne, was held on Wednesday evening, 9th inst., when a large gathering of the staff and branch office managers and agents from various offices in the United Kingdom were present. Mr. G. McCluskey, outside superintendent engineer, presided, and the following partners were present:—Messrs. Alfred Holmes, Ellwood Holmes, Stephen Holmes, and Oliver Holmes. The toast of the firm was proposed by Mr. T. Carter, chief engineer, and the amicable relations between the staff and the firm were emphasised. Mr. Alfred Holmes, the senior partner, when responding, said that he fully appreciated the loyalty of the staff and their efforts to make the business a success. A toast to the branch offices and agents was given by Mr. Stephen Holmes, and this was replied to by Mr. F. W. Varney, manager of the London branch. Mr. J. G. Adamson was responsible for the entertainment programme.

Wages Dispute at Liverpool.—Trouble is developing between the Electrical Trades Union and the Post Office authorities over the work of re-wiring the Liverpool General Post Office. The Union contends that its members should receive the district rate of 2s. 3d. per hour, but it is understood that the Post Office claims that this work should come under the schedule of rates paid by the Post Office Engineering Union.

Book Notices.—"Hydro-Electric Survey of India: Second Report on the Water-Power Resources of India." By F. E. Bull and J. W. Meares. Pp. 123; 17 figs. + plates. Calcutta: Superintendent, Government Printing Office. Price Rs. 1—6; or from Messrs. Constable & Co., London, or other agents for Indian Government publications.—This Report is referred to in our leading columns to-day.

"The *Transactions* of the South African Institute of Electrical Engineers." Vol. XII, Part 1. January, 1921. 22 pp. Price 2s.—This issue includes a report of the 12th annual general meeting, and gives a statement of income and expenditure for 1920 and the balance-sheet; also discussions on two papers:—"Notes on Small Suction Gas Plants," and "Power Requirements of Rolling Mills."

Combines of Japanese Electrical Companies.—Tokio will in future be a field of keen competition among several companies for the supply of electric power and lighting. In addition to the fairly numerous existing companies the Keihin Electric Power Co., the Kanto Water Power Electric Co. and the Gumma Electric Power Co. are now being organised. The combined supplying capacity of these, and the companies already in existence will soon far exceed the demand for the entire city and neighbourhood, and the question of regulating supply and demand is being considered by the respective companies as a matter of grave importance. It is probable that some companies will eventually combine in order to avoid competition. The Tokio Electric Light Co. which amalgamated with the Nippon Electric Light Co. some time ago, recenty amalgamated with the Tone Water Power Electric Co. The company is about to amalgamate with the Tone Electric Power Co., the negotiations for the combine having now been concluded. By this combine the Tokio Electric Light Co. will possess the supplying power of the two companies. In addition, the Tokio Electric Light Co. being a large shareholder in the Shinetsu Electric Power Co. controls a large supply of electricity from this source. The Shinetsu Electric Power Co. has recently amalgamated with the Nakatsugawa Water Power Co. which will shortly begin its power house operations, consequently the supplying capacity of the Shinetsu Co. is expected to increase considerably in the near future. In these circumstances the Tokio Electric Light Co. possesses a paramount position in the supply of electricity in Tokio and the neighbourhood.

A combine of companies in Kyushu is being planned, but details are as yet unavailable. It is conjectured that the Kyushu Hydro-Electric Co. (capital 35,000,000 yen), the Kyushu Electric Light Co. (capital 18,000,000 yen), and the Kyushee Electric Tramway Co. (capital 16,000 yen), will be amalgamated, and that ultimately the smaller concerns will be merged into the combination. —*Reuter's Trade Service* (Tokio).

Copper and Lead Prices.—Messrs. F. Smith & Co. report March 15th:—Copper (electrolytic) bars, £71, 20s. decrease; ditto sheets, no change; ditto wire rods, £87, £1 decrease; ditto h.c. wire, 11¼d., ¼d. decrease.

Messrs. James & Shakespeare report March 16th:—Copper bars (best selected) sheets and rod, £114, 40s. decrease; English pig lead, £20 10s., 20s. increase on last week's quotation.

The Scottish Electricians' Strike.—A statement issued by the Electrical Contractors' Association with reference to the dispute with the employés respecting wages, explains that at a conference the employers intimated that, on account of the state of trade, they found it necessary to stand fast to their notice regarding a reduction of wages, as their experience was that the public considered the cost of installation work too high, and consequently work could not be obtained at the existing rates to afford employment to the large majority of men in the trade. Shop notices for the reduction of wages to 2s. per hour for the first full pay in March were posted. The Union requested a further conference on the matter, and this conference was held on 4th inst., when no agreement was come to.

The Perth branch of the Electrical Trades Union has announced that it is prepared to supply direct labour to undertake all branches of electrical work, including armature winding. Estimates are given free. Those requiring such labour have been asked to apply to the Strike Secretary.

Kinematograph Electricians. — Representatives of the Electrical Trades Union and members of the Devon and Cornwall Branch of the Cinema Exhibitors' Association recently met in conference at Plymouth to open negotiations with regard to "a card" for kinema operators. The question of wages was one of the outstanding subjects discussed, a claim being made by the Union for £5 5s. a week for operators in "Class A" houses. The exhibitors opposed on the ground that it was in excess of the ordinary Union rate for electricians in the district—namely, 2s. 1d. an hour, which for a week of 48 hours made a wage of £5.

It was proposed with reference to "Class B" houses that chief operators should have £4 10s. a week, and that the assistant should be a non-technical assistant.

A discussion arose regarding the qualifications of operators and the training of apprentices. Mr. W. J. Corse, a kinema proprietor, and the head of an important electrical business in Plymouth and elsewhere, pointed out that many of the operators were not electricians. He worked for practically all the exhibitors in the district, and he had seen some of the best machines put into houses "mucked up" by inefficient operators within a week. Mr. F. J. Martin, for the Electrical Trades Union, retorted that exhibitors could not expect efficient men unless they paid first-class wages. Mr. Corse replied that as they paid at the rate of 2s. 1d. an hour, which was first-class wages for the district, they were entitled to expect first-class work.

Mr. Mont Gilpin (Chairman of the Exhibitors) said he was in favour of Union wages and Unions; but, on the other hand, he insisted that if they paid the Union rates for men, they must have efficiency. Very often it happened that men who became assistant operators started with no training except such as they got in the kinemas. As soon as these assistants turned the handle and threw a picture on the screen—no matter the quality of the picture—they immediately claimed to be first class operators.

It was ultimately decided that "apprentice operator" should be substituted for "non-technical assistant." It had been proposed that the non-technical assistant should be paid 35s. a week, but under the new agreement the apprentices are to be paid on a scale commencing at 15s., and rising by 5s. each six months for three years.

Earlier Posting of Commercial Correspondence.—Representations have recently been made to the London Chamber of Commerce both by the Controller of the London Postal Service and by the Union of Post Office Workers with regard to the extra pressure and risk of delay in the transmission of postal matter caused by the accumulation of correspondence in business houses for posting late in the day. The president and chairman of the London Chamber has issued a communication to members suggesting after having made independent inquiry into all the circumstances, so far as practicable, endeavours should be made:—

(1) To post letters as soon as they are ready at intervals during the day.

(2) To arrange for the posting of as much matter as possible at lunch time each day.

(3) To post, especially, printed matter, statements, invoices, &c. (*i.e.*, matter coming within the ½d. rate), before 3 p.m., wherever possible.

(4) To dispatch other bulk matter (*e.g.*, imitation typewritten circulars) in the same way.

(5) To reserve for the late afternoon and evening collections only those letters which cannot be posted earlier.

(6) To avail themselves more largely of the facilities afforded by private posting boxes under arrangement with the postal authorities.

Union of Manufacturers of Electrical Material in Spain.—A union of manufacturers of electrical material has been formed, with headquarters at Barcelona, for the purpose of defending the interests and furthering the development of the industry in Spain. The name of the union is Agrupacion de Constructores de Materiél Eléctrico de Espano, and the President of the Council is Don J. de Guilén Garcia.—*Reuter's Trade Service* (Madrid).

The Leipzig Fair.—The commercial prosperity of Germany was strikingly shown at the Leipzig Fair. The display of machinery, textiles, porcelain, and other products of German manufacture gave magnificent results. The first day's sales surpassed all expectations. There were 90,000 buyers, among them thousands of foreigners, including 500 from the Balkans, 8,000 from Czecho-Slovakia, and 300 from the United States and England.—*Daily Mail.*

French Lamp Combination.—It is stated that the Compagnie Thomson-Houston and the Compagnie Générale d'Electricité have decided to transfer their various lamp factories to a new French company which is to be formed with the co-operation of the General Electric Co., of New York. The two former companies will possess a large interest in the new undertaking.

Compulsory Trade Unionism.—Fulham Borough Council Electricity and Lighting Committee recommends that all employés under the full control of the Committee be required to be members of a recognised Trade Union, and that it be a condition of employment that a person not already a member of a Trade Union at the time of engagement in or about the Fulham electricity works shall join a recognised Trade Union within a fortnight of such engagement.

Foreign Trade.—February Figures.—The following are the values of imports and exports of electrical goods and machinery in February:—

	February, 1921.	*Inc. or dec.*	2 months, 1920. *Inc. or dec.*
Imports.	£	£	£
Electrical goods, &c.	217,235	+ 118,529	+ 283,305
Machinery	1,256,862	− 126,567	− 80,628
Electrical machinery	64,062	− 25,258	− 23,258
Exports.			
Electrical goods, &c.	1,123,801	+ 494,554	+1,099,058
Machinery	6,397,929	+3,654,692	+7,981,591
Electrical machinery	392,526	+ 259,800	+ 531,006
Re-exports.			
Electrical goods, &c.	30,042	+ 22,166	+ 41,062
Machinery	94,703	− 9,572	+ 42,838
Electrical machinery	3,187	+ 1,265	+ 7,945

Subsidy v. Unemployment Dole.—A novel proposal is made with a view to restoring the Welsh steel trade, and enabling it to regain foreign markets. Mr. Llewellyn Carter, general secretary of the South Wales section of the National Federation of Blast Furnacemen, has sent a letter to all the Welsh employers urging that steps be immediately taken to obtain Government aid for the iron and steel industry in the task of recapturing lost trade. He proposes that the Government be asked to enable the employers to accept any orders going by providing the difference between the cost of production and the international selling price, this form of temporary subsidy to displace the unemployment dole to the men. Subsidies do not represent the best form of encouraging trade, but as an alternative to unemployment pay they are worth discussion.—*Machinery Market.*

Demand for Machinery in China.—Electrical engineering in China, which since the Armistice has shown signs of considerable development, is at present experiencing a spell of stagnation, says the *North China Daily News*, owing to the recent drops in exchange. While the cost of machinery is about 225 per cent. above pre-war figures, it is only recently that the purchaser in China has suffered from this advance, but to-day, with exchange as low as it is, prices show an increase of something like 100 per cent. in taels. The result is that schemes which were in contemplation, and which would have meant large orders for the electrical engineering works of Great Britain and America, show a very strong tendency to remain in abeyance. There is little doubt that but for the drop in exchange, many of these schemes would have reached a concrete stage. In the case of a great many Chinese undertakings the plant is in urgent need of extension, and not only had these extension schemes been approved, but inquiry for the necessary machinery was afoot. At the same time, projects for entirely new undertakings had been formulated and the capital promised. At the more favourable rates of exchange this capital was perfectly adequate for the acquisition of the required plant, but to-day it is no longer so. As a consequence, many promising schemes appear to have been dropped, even though in some cases the machinery is urgently needed. It is impossible to say what will be the policy of these concerns. Up-country correspondents from time to time have had occasion to comment, for instance, upon the bad quality of electric light supplies by local companies, and while this is, doubtless, largely due to inefficient management and the indifferent care given to machinery, a certain amount is to be debited to overloading. It is to be feared that some such policy may be continued in the meantime, in view of the high cost of plant, but it is none the less certain that this will be only a temporary expedient, and that sooner or later a great number of Chinese concerns must come into the market for machinery. Just now it is impossible to say how long they can hold off, but apparently a first essential to their coming in will be a realisation of the fact that their undertakings will have to be capitalised on a more generous scale than they had previously prepared for.

One feature of engineering which promises to play a prominent part in the future is the suction gas plant. A question which has agitated the Chinese mind considerably is the relative cheapness of coal and of oil as fuel. And here the fact that coal is to be obtained locally, which means that its price is not subject to the vagaries of exchange, is a point which has received a good deal of attention on the part of the Chinese. In the circumstances, the presence of anthracite seems likely to operate in favour of the suction gas plant, the installation of which has already taken place in some cases on a comparatively large scale.—*Reuter's Trade Service* (Shanghai).

Faraday House Testing Laboratories.—During the 32 years of its existence the services of Faraday House (the Electrical Standardising, Testing, and Training Institution. Ltd., 66, Southampton Row, W.C. 1) as a testing institution have been utilised by many more engineers and others than it is convenient to recall. The scope of the work embraces everything that is supplied by the electrical and associated industries, and anyone can ascertain rapidly, for a reasonable fee, whether the machinery, apparatus, or materials he uses are fulfilling their requisite functions. Moreover, the testing department is kept separate from the other branch of the Institution's work; a special staff is engaged, and as the Institution does not engage in trade, it will be appreciated that it occupies a perfectly independent position. Faraday House undertakes, *inter alia*, electrical, mechanical, chemical, photometric, &c., tests; mathematical calculations and investigations are also made in connection with electrical machinery and apparatus, and the laboratories are frequently requested to make tests upon samples by manufacturers or their customers. A wide range of instruments may be hired, or a private workshop rented; advice and assistance is given to inventors, and arrangements can be made for the exhibition of their apparatus or models. Investigations into, and reports upon, inventions and electrical appliances are made, and the laboratories are connected with the public electricity supply mains, from which a constant supply of both d.c. and a.c. at high and low pressures is available; a special set has been installed to supply either single, two, or three-phase energy with a wide range of frequency.

Electrical Goods in South Africa.—In its issue for February 19th, the *South African Mining and Engineering Journal* stated that dealers reported a livelier state of things, and expected within a month to be very busy. Everybody seemed to be much more cheerful, and a more hopeful feeling was existent as to the future. As a result of the elections and the settlement of the labour unrest, many more orders were coming in from the country and other parts of the Union than had been the case for a long while. Prices remained unaltered. Materials were coming in freely, and all lines were well stocked. "Altogether, one gathered the impression that there was now more spirit, more go, in the electrical wares business than has been noticed for some months past."

Exhibition at Gothenburg.—An exhibition is being arranged in Gothenburg, to take place in 1923, in which many arts and industries will find a place. The main object of the exhibition is to illustrate the development of Swedish industry during the past 300 years. Iron and steel products will play a large part in the show.

For Sale.—Glasgow Corporation Tramways Department has for disposal 20 G.E. 52-type 25-h.p. traction motors, and 18 B 13 controllers, with various spares. By direction of the Disposal Board, Messrs. A. T. & E. A. Crow will offer by auction on April 7th, at Lemington-on-Tyne, machinery, tools, electric plant, motors, &c. The Lancashire and Yorkshire Railway Co. have for sale one Yates & Thom compound-vertical engine direct coupled to a 750-kW Dick-Kerr generator, complete with condensing plant, &c. For particulars, see our advertisement pages to-day.

Halifax Corporation Electricity Department invites offers for two Babcock and Wilcox water-tube boilers.

Beckenham Urban District Council Electricity Department has for sale one 120-kW Bellias-Fowler single-phase alternator and exciter.

LIGHTING AND POWER NOTES.

Aberystwyth.—Sale of Undertaking.—The Town Council has agreed, subject to the satisfaction of the Electricity Commissioners as to the position, financially and otherwise, of British Properties, Ltd., to the assignment to this company of the undertaking of the Chiswick Electricity Supply Corporation, Ltd.

Barnes.—Progress of Extensions.—Contracts to the value of £56,069 have been placed by the Urban District Council. The engine room and switch room are nearly completed, and it is hoped to commence the erection of the new generators shortly. The boiler and economiser foundations have been completed, and the boiler makers will soon commence erection. Practically the whole of the coal storage and handling plant has been delivered.

Barrow.—Mains Extensions, &c.—At the Town Council meeting on March 7th, considerable mains extensions were approved. The recommendation to share a cost of £500 as expenses of the joint committee of the proposed Furness, South Cumberland, and Lancaster area electricity committees was approved, the amount being divided between the different authorities in proportion to their rateable values and populations. The meeting approved the recommendation of the General Purposes Committee that the Council retain its membership of the Incorporated Municipal Electrical Association, but decline to be governed by the Association with regard to the salaries of the staff. Approval was also given to the setting up of a works joint committee as soon as possible for the electricity works undertaking, and the town clerk and the borough electrical engineer are to prepare and submit a draft constitution of this committee. With regard to electricity works extensions, the committee reported that the engineer had written to Messrs. Vickers with reference to their power house at Barrow Island, and had not proceeded with the Backbarrow scheme.

Bexley.—Revision of Terms Refused.—The Urban District Council has been endeavouring to obtain a revision of the agreement under which electricity is supplied in bulk to the Foots Cray Electric Supply Co., but the latter has replied that it cannot agree to the Council's proposals, and asks for terms under which the Council would be prepared to supply it in bulk up to 1935. The engineer advises the Council not to enter into such an agreement, and the entire matter has been referred to the clerk for advice. At present the supply to the Foots Cray Co. is maintained at a loss.

Blackpool.—New Supplies.—The electricity department has sufficient service work to keep it busy for three months ahead, and it has been decided not to accept, for the present, applications for supply which involve extensions of mains, or where a supply of gas is already available.

Bo'ness.—Bulk Supply.—To meet the growing demands upon the electricity works, the Town Council has arranged for a bulk supply to be obtained under agreement with the Scottish Central Supply Co., subject to the approval of the Electricity Commissioners, who are to be asked to sanction an expenditure of £20,000 for converting plant.

Bradford.—Direct Labour Decision.—At a City Council meeting it was decided that the work of wiring the Corporation houses being erected by direct labour should be carried out by properly authorised wiring contractors and not by direct labour. Mr. Longley said the 50 electrical wiring contractors in Bradford worked in very harmonious relationship with the electricity department, and there was an honourable agreement that, provided they did not form a ring to keep up prices, the department would not enter into competition with them in trade. He suggested also that the Corporation could not wire houses at the prices at which contractors in the trade could do it. He mentioned that the necessity for this motion arose out of the behaviour of direct-labour, general workmen at the Bradford Moor housing site who threatened to strike when a private firm, by contract, sent its men to do wiring. The Trade Union leaders had had to intervene to prevent a strike. Alderman Barber, secretary of the Trades and Labour Council, protested against what he termed the spirit of the resolution, and said it gave preference to certain sections of the community.

Brandon.—Street Lighting.—The Urban District Council has received a communication from the County of Durham Electrical Power Distribution Co. stating that, as so many contingencies might arise which would have to be provided for, it would be an extremely difficult matter to quote a definite price for converting the present system of street lighting to electric lighting. It was of opinion, however, that the work could be carried out at a cost of between £2,000 to £3,000.

Burton-on-Trent.—New Plant.—After considering the purchase of a second-hand 2,000-kW set, or alternatively a new 5,000-kW set, the Electricity Committee has decided to recommend the latter. This will involve alterations to the station and switch house. The total cost is estimated at £50,930.

Continental.—Spain.—The King has received a deputation which presented to him in the name of the Instituto de Ingenieros Civiles and the first Congress Nacional de Ingeneria, a project for the construction of a national system of distribution of electrical energy prepared by the most eminent technical experts in Spain. It is proposed to contruct a great system covering the whole of the country, the total length of the lines being some 6,500 km. The direction of the lines would be determined by the principal rivers, the great railway lines, in order to facilitate their eventual electrification, and the most important power producing and consuming centres. In this system would be incorporated power derived from water falls and central stations, and the latter could use *in situ* the coal of inferior quality so abundant in the country. Every consumer will be able to find power up to 50,000 kW within a distance of 80 km. The cost of the scheme is reckoned at about 200 million pesetas, which is not a high figure if it is borne in mind that power would be available at practically any point in the country at a price less, perhaps, than five centimos per kWh.—*Reuter's Trade Service* (Madrid).

France.—M. Millerand, President of the Republic, has made his first official journey through France in connection with the great scheme of harnessing the Rhône. He was accompanied by experts from the departments through which the Rhône flows, and the gigantic project was explained to him by means of plans. Speaking at Lyons on March 13th, he expressed the hope that the scheme would contribute in a striking manner to the renaissance of France. This is a tremendous work, and includes the harnessing of the Rhône from the Swiss frontier to the sea, and, when completed, and electrical power is distributed, navigation developed, and huge tracts of land irrigated, it is prophesied that France will have a national equipment which will compensate her for her economic disasters in the war. It is computed that her waterfalls will be able to develop 9,000,000 h.p., the basin of the Rhône alone furnishing 1,700,000, of which 800,000 can be utilised. The undertaking is divided into six sections, and the work, which will begin in 1924, will last six years at most. The cost is put at 2,200,000,000 fr. (about £88,000,000 at normal exchange). Seventeen power stations are planned, and the energy they will produce will be equivalent to that obtained from 6,000,000 tons of coal. From the agricultural

point of view over 400,000 acres of land will be put under cultivation, irrigated, and cleaned, and by the system of harnessing the river it will be possible to begin intensive navigation on the upper reaches, and between Lyons and Arles, thus creating a wide waterway which, with the Rhine, will connect the Mediterranean and the North Sea. Financial experts have pointed out that the annual expenses will exceed by several million francs the receipts, but, on the other hand, it is argued that the indirect advantage to the communes and to the State will make up for the deficit. The State, the towns interested, and certain companies which have obtained concessions will subscribe to the scheme, the State guaranteeing the interest on the money, and eventually participating in the profits. The Swiss Government has given its approval to the project.—*Daily Telegraph.*

ITALY.—The plans have been prepared for the development of the waterfalls on the Upper Avisio and the Noce, in the Trentino, which will benefit Malé and the whole of the Valle del Sole. The water gathered by special plant installed at Peio and Cogolo will be impounded in a large reservoir constructed at Pian di Palu, and that drawn by a special plant situated at Pelizzano and at Malé will be stored in a second great reservoir at Pelizzano and Mezzana. Whole fields, meadows, and woods will be displaced to make room for these two storage lakes. An idea of the extent of the works may be obtained from the fact that the Pian di Palu reservoir will have a volume of 38,000,000 cb. metres and an area of 900,000 square metres. It is estimated that the scheme will yield from 150,000 to 180,000 h.p. of electrical energy.

CZECHO-SLOVAKIA.—A Bill introduced into the Parliament of the Czechoslovak Republic proposing to tax hydro-electric undertakings has called forth the liveliest opposition from owners of these undertakings. Public meetings have been held, and a memorial has been forwarded to the Government. The introduction of such a tax, the memorialists declare, is most harmful, particularly at a time when, owing to the coal famine, the development of the country's water resources is most urgently required in the interest of national welfare. The amount of the proposed tax cannot be justified, and its effect will be injurious to the many struggling industries of the country. Should the tax be persisted in, the memorial asks for a drastic revision of its amount of incidence by an official Commission to be appointed for the purpose. The Government's proposal was a flat rate of 10 heller per h.p., and the memorialists submit the following modifications:—(1) Total remission of the tax in the case of saw and paper mills, &c., where its imposition would mean the stoppage of such undertakings; (2) a tax of ½ heller on undertakings with extraordinarily high foundation and working costs; (3) a tax of ¾ for undertakings with more than normal building and working costs; (4) a tax of 1 heller per h.p. on undertakings with normal building and working costs. Certain other stipulations are also put forward.—*Trsa.*

Dundalk.—LOAN. — The manager of the electricity department reported to his Committee that a further loan of £2,000 would be required to meet the liabilities due in respect of new cable and services, a new cooling tower, &c. The Urban Council approved of the recommendation.

East Africa.—DAR-ES-SALAAM.—Progress is being made with Dar-es-Salaam's electric lighting scheme, which includes the completion of a large new power station and the relaying of the main supply lines with necessary feeders and network boxes to facilitate testing and maintenance.—*British and South African Export Gazette.*

Electricity District. — NORTH-EAST MIDLANDS.—The Electricity Commissioners give notice that they have further extended the time within which objections and representations in connection with the above-named district may be made from the last day of this month to June 30th, 1921.

Falmouth.—BULK SUPPLY NEGOTIATIONS.—The Town Council has decided not to transfer its electric lighting powers to Messrs. Herd & Smith, Ltd. The Council is negotiating with the Cornwall Electric Power Co. for a bulk supply.

India.—EXTENSIONS AT PONDICHERRY.—H.M. Consul at Pondicherry (Captain H. G. Tranchell) has informed the Department of Overseas Trade that the sum of 65,000 rupees has been voted by the Conseil Général of that place for repairs and new machinery in the municipal electricity works. H.M. Consul states that probably most of the equipment will be obtained from Madras or Bombay.

Japan.—SEMI-OFFICIAL SCHEME DEFERRED.—It is stated that the Government has decided to give up for the present the proposal to organise a semi-official electric power company in view of the antagonism shown to the scheme, and the possible financial difficulties involved. The railway authorities, however, will go on with their electrification programme, which has been already drawn up, and will build a power station on the Shinano River at a cost of 500,000,000 yen.—*Reuter's Trade Service* (Tokio).

Kingstone.—ERECTION OF POLES BANNED.—The Urban District Council has declined to allow Mr. J. H. Langston to erect electric light standards in the town, as the scheme of the Hereford Town Council already has been supported. The Council has asked Hereford when the scheme is to be carried out.

Lancaster.—PROPOSED SUPPLY TO MORECAMBE.—At a meeting of the Lancaster Town Council it was reported that Morecambe Corporation had intimated that, as both authorities desired to extend their electricity undertakings, the Commissioners had suggested a conference of the two bodies, with a view to arranging a scheme for the extension of one of the works to enable both boroughs, and possibly neighbouring townships, to be supplied therefrom. Morecambe offered to take a supply of 400,000 units per annum from any such extension of the Lancaster works. The meeting approved the appointment of a Sub-Committee of the Electricity Committee to meet the Morecambe representatives.

Lincoln. — PROPOSED PRICE INCREASE. — The Town Council has applied for permission to increase the price of electricity from 8d. to 1s. per unit, and the quarterly minimum payment from 13s. 4d. for 20 units to 15s. for 15.

Malvern.—PROPOSED ELECTRICITY SUPPLY.—The Gas and Electricity Committee is arranging an interview with the Shropshire, Worcestershire, and Staffordshire Power Co. to discuss the question of terms under which the company would be prepared to supply the Malvern district.

Paisley. — SUPPLY NEGOTIATIONS ENDED. — Messrs. J. & P. Coats, Ltd., have decided to extend their own electricity generating station at Ferguslie Thread Mills rather than purchase a supply from an outside source. The decision brings to a close protracted negotiations between the firm and several local electricity supply authorities, including Paisley Corporation.

Plymouth.—LOAN SANCTIONED.—At a meeting of the Electricity Committee, the town clerk reported that the Electricity Commissioners had sanctioned the borrowing of the sum of £20,000 for a period of 20 years for the purposes of a new converter, switchboard, switchgear, &c.

Newcastle.—REDUCED LIGHTING.—In an endeavour to reduce costs the Lighting Committee has decided to reduce the city lighting by 40 per cent.

Rotherham.—PROPOSED LEASE OF STATION.—At a meeting of the Electricity Committee the town clerk submitted a letter from the Yorkshire Electric Power Co. asking whether the Corporation would be prepared to lease its new power station to the company, subject to a provision ensuring the Corporation a supply for customers in its area. The Committee recommended that the application be not entertained.

Runcorn.—UNITED ALKALI CO.'S POWER STATION.—The new power station of the United Alkali Co., at Runcorn, is a fine modern building designed to house four 5,000-kW sets, two of which are already installed. The Metropolitan-Vickers Co. supplied the h.p. switchgear of the cellular type with duplicate bus-bars for controlling the main generators and feeders. Eight of the 12 Babcock & Wilcox water-tube boilers are in commission, each being designed to produce 25,000 lb. of steam per hour at a pressure of 220 lb. per sq. in.

Sheffield.—PROPOSED PRICE REDUCTION.—Owing to the realisation of a substantial profit upon the undertaking, the general manager of the electricity department recommends that the increase of 150 per cent. upon all supplies at the price of 2d. per unit and under, put into force as from last September, shall be reduced to 125 per cent. as from the December meter readings.

Stafford.—LOAN.—At the monthly meeting of the Town Council, the Finance Committee reported that the borrowing of a further £33,800 had been sanctioned, in respect of the Council's application for £78,000 for the extension of the electricity works.

Steyning.—SPECIAL ORDER.—The Steyning Electric Light Co., Ltd., is applying to the Electricity Commissioners for a special order authorising the company to generate and supply electricity within the parishes of Steyning, Bramber and Beeding.

Sunderland.—PRICE INCREASE DEFERRED.—The Town Council has declined to sanction an increase in the tariff of the low-pressure network, as proposed by the Electricity Committee. The matter was referred back to the Committee with an instruction to circulate a detailed financial statement in support of the increases. The chairman of the Committee stated that during the past few months they had spent about £23,000 in connection with the low pressure supply, and a further £17,000 would be spent in the course of the next two years for necessary upkeep. Wages had recently gone up by £1,800, and the Committee felt that the consumer should pay for what he used rather than that the ratepayers should subsidise the supply.

Taunton.—LOAN.—The Town Council has applied for a loan of £1,000 for meters, principally for 200 new houses being built.

Walsall.—LARGE MAINS EXTENSION.—The Electric Supply Committee proposes to make an extension of mains to Messrs. Harrison's No. 3 pit at Wyrley, at a cost of £14,250.

Whitehaven.—LOAN.—The Town Council has applied for a loan of £1,420 for the purpose of supplying electricity to Kells, where there are 180 prospective consumers.

Worcester.—ELECTRIC LIGHT FOR HOUSES.—At a recent meeting the City Council had before it the question of lighting 150 houses, being built under the housing scheme. It was moved that the laying of electricity mains should be suspended and gas lighting should be installed. An amendment that the houses should be lighted electrically was carried after some discussion.

York.—County Council and Proposed Station.—The Agricultural Committee of the West Riding County Council reports that it has considered the proposals of the York Corporation to erect a power station at Linton Lock, and is advised that the proposals as they now stand would be detrimental to the interests of draining agricultural land and this view has been placed before the Corporation with a view to such proposals being modified to safeguard the interests of the agricultural community.

TRAMWAY AND RAILWAY NOTES.

Australia.—Proposed Toowoomba Tramways.—The second report of the consulting engineer on the proposed system of tramways for Toowoomba was on practically the same lines as the previous one, with the addition of a recommendation that a transmission line be constructed from Ipswich to Toowoomba to carry electric power from Brisbane, in preference to the establishment of the Council's own power house, as the cost of power secured from Brisbane would be considerably less. The cost of the tramway is estimated at £147,184, and the transmission line, substations and apparatus at £73,827, making a total of £221,011.—*Tenders.*

Barrow.—Inquiry.—At the Town Hall, on March 10th, Mr. J. C. Dawes, O.B.E., one of the inspectors of the Ministry of Health, held an inquiry into the application of the Town Council to borrow the sum of £6,650 for the purchase of four electric vehicles for use in connection with the disposal of house refuse. Evidence was given as to the financial position of the borough, and it was pointed out that two motor vehicles were at present in use, in addition to 12 horses and carts, for the removal of house refuse. It was proposed to have the four electric motor wagons, to dispense with 10 horses and carts, the cost per ton being about 1s. 1d. less. The Corporation possessed a garage sufficiently large to accommodate the additional motor wagons, but would have to install further electric charging apparatus, which, with the adaptation of the building, was estimated to cost £810, which was included in the amount required. There was no opposition, and the inquiry was concluded.

Loss on Tramways.—At the Town Council meeting on March 7th, the chairman of the Electric Tramways Committee moved the adoption of the minutes showing that the estimated loss on the undertaking for the 15 months ending March 31st next, during which time the Corporation had been the owners, was £15,680, which was equal to a rate of 9d. in the £. In a long statement the chairman took the Council back to the time when the Corporation entered into negotiation with the British Electric Traction Co., pointing out that the system was electrified in 1904, and provision was made for the purchase on clearly defined lines at the end of 7, 14, or 21 years. The matter was considered at the end of the first seven years, and, after receiving reports from the Corporation officers, no action was taken. At the beginning of 1919 an agitation arose amongst a certain number of the inhabitants of the town, and they pressed the Corporation to acquire the undertaking. The reports of the officers inspecting the system recommended the Corporation to take advantage of its powers, and purchase, as they considered the capital cost to the Corporation would be much less than it would be under the provisions of the agreement at the end of 21 years. This advice the Council followed, and the undertaking was purchased as from January 1st, 1920, for the sum of £96,250.

The Committee regretted having had to increase the fares, and now having to make this heavy demand upon the ratepayers, but it felt it was the only satisfactory course to follow. The alternative would be to carry the deficit forward in the hope of making it good in future years, but in view of the uncertainty with regard to tramway finance, it considered these initial losses should be dealt with now.

Bradford.—One-Man Cars.—Though the Ministry of Transport recently rejected the Bradford Corporation's application for power to build a number of additional double-deck railless cars to replace the existing railed service on three routes—the idea being to economise by avoiding the relaying of the lines—sanction has been secured to the reconstruction of the city's railless car service, so that the cars can be run by one man per car. This, of course, will effect a great saving, and it is hoped that it will make the railless cars a paying concern. Hitherto they have been worked at a loss because they are not big enough to carry the number of passengers necessary to enable them to pay whilst requiring two men. The railless system, advantageous as it is in many ways, lost £8,000 last year. The work of reconstruction is to be commenced immediately. The new design will be such that passengers will enter and leave by the front platform, paying their fares to the driver.

Belgian Contract.—On the adoption of the Tramways Committee's minutes, at a recent meeting of the City Council, the chairman of the Committee, in reply to questions, agreed that a tender had been accepted from a Belgian firm for acid steel tramway tires, but the firm had written subsequently saying they had made a mistake, and their quotation had been for basic steel. The contract had not been re-let to the Belgian firm, and would not be until the matter came before the Committee and the Council. It may be remembered that there was a good deal of controversy locally over this letting of a contract to a foreign competitor of British firms which tendered, and whose quotations were considerably higher.

Brampton (Cumberland).—Survey for Tramway Route.—The Cockermouth Electric Power Co. has commenced a survey of the route from Cockermouth to Southwaite, Wreay, Wetheral, and Brampton, in connection with a proposed electric tramway, and with a view to supplying electricity to Brampton and the villages *en route*.

Burnley.—Special Rate.—The Finance Committee, on March 10th, decided to levy a special rate of 5d. in the £ for the Corporation tramways, which last year showed a loss of £12,000.

Huddersfield.—Tramway Developments.—Substantial development schemes in local constructional work are in contemplation by the Tramways Committee. When the new depôt at Longroyd Bridge is completed, it is intended to build tramcars locally.

L. and Y. Railway.—Projected Electrification.—The reconstruction and electrification of the whole of the line on the Lancashire and Yorkshire system between Southport and Ormskirk is under consideration. This information was given by Mr. Edgely, when reporting to the Lathom and Burscough Urban District Council, on the result of a deputation to Mr. Ashton Davies, passenger superintendent of the L. & Y. Railway, asking for certain improvements. When the proposed scheme has been carried out, it will mean that there will be a complete circuit of electric railway from Liverpool along the coast line through Formby, returning *via* Blowick, Burscough and Ormskirk, where it will link with the present electrified line from Liverpool to Ormskirk.

Leeds.—New Tramway.—The new tramway and road-widening scheme for Roundhay Road, under which it is intended to build a special tramway road separate from ordinary traffic, is estimated to cost £26,650, and will provide a great deal of work for the unemployed. In favour of the scheme it has been argued that the cost of relaying the tramway rails on the existing road would be £28,000, so that the Committee claims it will save £2,000, provide work for the unemployed, and secure a very important roadway and traffic improvement.

London.—Conductor's Power to Arrest.—It was stated in a case at Old Street Police Court on March 12th that a tramcar conductor had power under the Tramways Act to arrest a passenger. In the case in question it was suggested that the conductor was not arresting but merely detaining a drunk and disorderly passenger until he could call a constable. The Magistrate said the section of the Act referred to seemed to cover power of arrest.—*Morning Post.*

Paisley.—Proposed Sale of System.—The Glasgow Tramways Committee has received a letter from the Paisley District Tramways Co. intimating the latter's readiness to negotiate for the sale of the tramways to the Glasgow Corporation.

Portmadoc.—Light Railway Approved.—At a meeting of the Portmadoc Urban District Council it was stated that the construction of the proposed light railway from Carnarvon to Portmadoc, *via* Beddgelert, had been approved by the Government.

Sunderland.—Result of Through Running.—At a recent meeting of the Town Council the chairman of the Tramways Committee (Ald. G. New) presented a report on the experience gained so far in the new system of through running by the District Co.'s cars over the Corporation route from Grangetown to the centre of the town. He stated that if through running was continued it would result in a loss to the Corporation on the Grangetown route of £4,000 per annum. The Council decided that consideration of the matter should be adjourned pending the issue of a detailed statement to the members.

Wolverhampton.—Proposed Fare Increase.—The Corporation has decided to apply for permission to raise the fares on its tramway system, owing to the losses which have occurred under the present rates. The application requires the substitution of a maximum of 1½d. per mile for the existing maximum of 1d. per mile.

TELEGRAPH AND TELEPHONE NOTES.

A New Automatic Telephone.—The L.M. Ericsson Telephone Co., of Stockholm, has held a demonstration of a new automatic telephone exchange on the Hultman-Ericsson system, which has been perfected after experiments extending over seven or eight years. By the new system, operators are entirely eliminated, and every subscriber, by a simple manipulation, can obtain connection with any number desired. Large orders for installations of the new exchange are being obtained from abroad; among others, one has been obtained from Rotterdam for an exchange to serve 5,000 subscribers.—*Reuter's Trade Service* (Stockholm).

Bulgaria.—Press Telegrams.—After March 15th, Press telegrams will be accepted between the hours of 6 p.m. and 9 a.m. for transmission between the United Kingdom and Bulgaria at the rate of 2½d. per word, with a minimum charge of 10d. per telegram, says *The Times*.

India.—Cable Rates.—Cable rates from India to Europe will be increased, as from April 1st, from 1s. 6d. to 1s. 8d. per word, says *The Times*.

Telephone Service.—Select Committee.—On the 9th inst. Col. Gibbs, one of the Government Whips, placed on the order paper of the House of Commons a motion for the appointment of the Select Committee to inquire into the organisation and administration of the telephone service and the method of making charges; the Committee to have power to appoint from outside its own body such persons as it may think fit for the purpose of obtaining special expert or scientific information or advice upon the subject matter of its order of reference. The following is a list of the members proposed for appointment to the Committee:—Mr. Evelyn Cecil, chairman, Major Evan Hayward, Mr. John Hodge, Mr. Gerald Hohler, Mr. J. Stanley Holmes, Gen. Sir Archibald Hunter, Sir Evan Jones, Mr. Robert Lynn, Mr. W. Lane-Mitchell, Capt. A. H. Moreing, Mr. W. G. Perring, Mr. Alexander Richardson, Mr. A. K. Rodger, Mr. W. S. Royce, and Mr. A. E. Waterson. The Committee met for the first time on Tuesday, and the inquiry is to be conducted in public.

Night Service for Motorists.—The Automobile Association has installed over 50 sentry boxes along the main roads of the country, in which are fitted telephones for the use of members. During the past 18 months members have been provided with special keys, enabling them to open the boxes and use the telephones at night time, after the A.A. road patrol in charge has gone off duty. To enable members more easily to locate these telephones after dark, the Association, says the *Manchester Guardian*, has for some months past experimented with systems of illumination. The first roadside telephone box to be illuminated is that situated on the Epsom Road, near Ashstead. The Association has decided similarly to illuminate the telephone signs attached to all the roadside telephone boxes, except where the boxes are well indicated by public lighting services.

New Exchange.—Following the inauguration of the new Langham exchange, as reported in our last issue, subscribers on the old National system connected to the Redhill exchange were on the 12th inst. transferred to an exchange with up-to-date magneto equipment. The change, says *The Times*, is in pursuance of the policy of reconstruction being carried on in almost all the outer London exchanges, many of which are being practically rebuilt and improved by the addition of new lines.

Trans-Atlantic Cable Purchase.—Speaking on a vote for £2,672,500 for salaries and expenses of the Post Office, including telegraphs and telephones, in the House of Commons on March 14th, Mr. Pike Pease (the Assistant Postmaster-General), said the Government had purchased from the Direct United States Cable Co., at a cost of £570,000, a trans-Atlantic cable, for the purpose of coping with additional Imperial traffic, and to provide an alternative line in case of interruption of the Imperial cable owned by the Government. The purchase price included a stock of cable and cable stations at Ballinskelligs, Harbour Grace (Newfoundland), and Rye Beach (United States). To lay a new cable would have cost about £1,000,000. The cable was transferred to the Post Office on November 4th last. Laid originally in 1874-5, one-half of it had since been replaced by new cable. The total length was 3,197 miles.—*Daily Telegraph*.

Turkey.—Wireless Telegraphy.—It is reported that the Société Radio-Télégraphique Parisienne is negotiating with the Imperial Ottoman Bank with a view to the establishment of a wireless post on the bank premises. The same company has offered to buy the building now used as a police station at Galata Sari in the centre of Pera, which belongs to the Ministry of Finance.—*Reuter's Trade Service* (Constantinople).

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 27th. Victorian Railway Commissioners, Spencer Street. Caustic soda primary cells, complete (Contract No. 33,914).*

May 2nd. Victorian Railway Commissioners. Twelve miles of '015 sq. in. two-core, lead-sheathed, wire-armoured, 2,200-V cable.*

June 22nd. Victorian Railways. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery charging equipment.—*Reuter's Trade Service* (Melbourne).

Brisbane.—March 30th. P.M.G.'s Department. Switchboard apparatus and parts.*

Morwell Power Scheme. The Electricity Commissioners of Victoria have made certain alterations, alternatives with additions, to the specifications which will necessitate tenderers cabling any consequent amendments of their tenders before March 31st. See our advertisement pages to-day for further particulars.

Bedford.—March 31st. Electricity Department. Electricity meters, h.p. and l.p. cables, for 12 months. (See this issue.)

Belfast.—April 25th. Electricity Department. E.h.p. and l.p. switchgear. (See this issue.)

Belgium.—March 23rd and April 6th. The Société Nationale des Chemins de Fer Vicinaux, 14, Rue de la Science, Brussels. Laying of the underground armoured cables required in connection with the supply of electricity to the Brussels-Haecht line and the lines in the Louvain section. Particulars can be obtained for 3 francs from the Services Electriques, 48, Rue Montoyer, Brussels.

Belgrade.—May 1st. The Serb, Croat, and Slovene Ministry of Public Works. Erection of a power-station, main conductors and transforming stations in connection with an electrical scheme at Kostolac for the supply of energy to Belgrade, Semlin, &c.*

Dundee.—March 26th. Tramway Department. Twelve months' stores, including insulated wire, lamps, switches, and overhead equipment. The Manager.

East Ham.—April 2nd. Electricity Department. L.p. paper-insulated, lead-covered, armoured concentric cable, with necessary joint boxes, &c.; also two c.i. lighting feeder pillars. (See this issue.)

France.—April 5th. The French State Railway authorities, 43, Rue de Rome, Paris. Supply of four 8-ton electric travelling cranes for the new railway workshops at Sotteville-Quatre-Mares, Rens. Particulars may be obtained from the Services Electriques (1st Division) at the above address.

Halifax.—March 23rd. The Board of Guardians. Electrical fittings required during the six months ending September 30th next. Mr. A. T. Longbottom, Clerk, Union Offices, Carlton Street, Halifax.

Liverpool.—March 19th. Electrical supplies for West Derby Union. Mr. H. P. Cleaver, Union Clerk, Union Offices, Brougham Place, Liverpool.

London.—H.M. Office of Works. April 12th. Supply of electrical labour-in-daywork in the Leeds district. (See this issue.)

Manchester.—April 7th. Electricity Committee. High-pressure steam and water valves; high-pressure steam and water pipes, steam receivers, &c.; weighbridges and automatic coal-weighing machines; electric and hand-operated cranes. (March 11th.)

March 21st. L. & Y. Rly. Co. Six months' supplies of stores, including signal, telegraph and electric fittings, and signal, telegraph and electric light wires. Specification from Mr. Sharp, Stores Department, Osborne Street, Manchester.

Perth.—March 21st. Electricity Department. One 1,000-kW, d.c., geared turbo-generator, with condensing plant. (March 4th.)

Runcorn.—March 19th. Castner-Kellner Alkali Co., Ltd. Construction of light railway and sidings to connect its works with the L. & N.W. Rly. Co.'s Runcorn Dock branch. Lt.-Col. H. F. Stephens, engineer to the company, 23, Salford Terrace, Tonbridge, Kent.

South Africa.—Pretoria.—May 10th. Municipality. Switchgear. Tenders, marked "Electric Light and Power Department, 1920 Extensions, Contract No. 5," to Deputy Town Clerk, Municipal Offices, Pretoria, on May 10th. Deposit, five guineas. Further particulars may be obtained from the general manager of the Electric Light and Power Department, or from the consulting engineer, Mr. G. M. Clark, 40-42, Meischkel's Buildings, Johannesburg.

Johannesburg.—March 30th. Municipal Council. Forty 50-h.p., 500 to 600-V tramcar motors. Tenders to Town Clerk, Municipal Offices, Johannesburg.*

Uruguay.—Monte Video.—March 29th. State Power House. Single and three-phase meters.*

Wimbledon.—March 29th. Electricity Department. Annual contracts for cables and conduits, joint boxes and jointing materials, transformers, meters, &c., lubricating oils. (March 11th.)

Worksop.—April 6th. Electricity Committee. E.h.p. and l.p. cables; e.h.p. and l.p. switchgear; transformers; 500-kW rotary or motor converter. (March 11th.)

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Ten firms submitted tenders on March 1st to the municipal authorities of Antwerp for the supply and erection of an electrically-operated pump for the No. 7 dry dock at the Lefebvre basin. The lowest offer, 21,645 fr., was that of the Société de Construction Electrique de Belgique, of Brussels.

London.—L.C.C.—Highways Committee. Accepted.

10,000 track insulators.

Bullers, Ltd. (accepted)	**£637 10**	per 1,000
Park Royal Engineering Works, Ltd.	687 10	"
" " " " alternative ..	675 0	"
R. A. Bradshaw & Son	825 0	"

HAMMERSMITH.—Electricity Committee :—

Air-cooler for use in connection with the 10,000-kW turbo-alternator, £1,175.—C. A. Parsons & Co., Ltd. (recommended).
Boiler feed-pump, £293.—G. & J. Weir, Ltd. (accepted).
2,000 yd. ·05 sq. in. and 500 yd. ·2 sq. in. l.p. cable, £831.—Hackbridge Cable Co., Ltd. (recommended).

Sheffield.—The Corporation has placed an order with the Leeds Steel Works for 1,000 tons of rails for the tramways at £24 per ton.

Sunderland.—Corporation.

House service cable.—Enfield Ediswan Cable Works, Ltd.
Section pillars.—Henley's Telegraph Works, Ltd.
E.h.p. switchgear.—Ferguson, Pailin & Co., Ltd.
E.h.p. joint boxes.—W. G. Farrow.

Tramways Department :—

Radial truck, £90.—J. G. Brill Co.

Weymouth.—Town Council.

Worthington-Simpson, Ltd.—Air and force pumps for turbine, £794.
A. Curtis.—Electric welding repairs to boiler, £88.

Wolverhampton.—Electricity Committee.

E.h.p. and l.p. cables for 12 months.—Callender's Cable and Construction Co., Ltd.
Repairs to transformer, £228.—British Electric Transformer Co., Ltd.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, March 18th. At the Institution, Storey's Gate, S.W. At 6 p.m. Paper on "Contact Pressures and Stresses," by Prof. E. G. Coker, F.R.S., Mr. K. C. Chakko and Mr. M. S. Ahmed.

Royal Institution of Great Britain.—Saturday, March 19th. At Albemarle Street, W. At 3 p.m. Lecture on "Electricity and Matter," by Sir E. Rutherford, F.R.S. (Lecture III.)

Royal Society of Arts.—Monday, March 21st. At John Street, Adelphi, W.C. At 8 p.m. Cantor Lecture: "X-Rays and their Industrial Applications," by Major G. W. C. Kaye.

Faraday Society.—Tuesday, March 22nd. At Burlington House, Piccadilly W. At 8 p.m. Ordinary meeting.

Institution of Electrical Engineers.—

Liverpool Sub-Centre.—Monday, March 21st. At the University, Liverpool. At 7 p.m. Paper on "Electric Driving in the Paper Mill on Heat-economy Lines," by Mr. A. B. Mallinson.

North-Western Centre.—Tuesday, March 22nd. At the Engineers' Club. At 7 p.m. Paper on "The Long-Distance Telephone System of the United Kingdom," by Sir William Noble.

South-Midland Centre (Students' Section).—Tuesday, March 22nd. At the University, Birmingham. At 7.30 p.m. Paper on "Prime Movers in Small Power Stations," by Mr. H. E. D. Carter.

Institution of Engineers and Shipbuilders in Scotland.—Tuesday, March 22nd. At 39, Elmbank Crescent, Glasgow. At 7.30 p.m. Paper on "The Dalmarnock Power Station," by Mr. R. B. Mitchell.

Institute of Railway Signal Engineers (Incorp.).—Wednesday, March 23rd. At the Midland Grand Hotel, St. Pancras, N.W. At 6 p.m. Paper on "Fundamental Calculations of A.C. Track Circuits," by Mr. D. C. Gall.

Manchester Wireless Society.—Thursday, March 24th. At the Manchester College of Technology, Sackville Street. At 7.30 p.m. Lecture on "Direction Finding," by Mr. J. Hollingworth.

Edinburgh Electrical Society.—Friday, March 25th. At the Philosophical Institute. At 8 p.m. Paper on "Automatic Telephones," by Mr. W. Leithead.

Manchester Association of Engineers.—Saturday, March 26th. At the Memorial Hall, Albert Square. At 7 p.m. Annual general meeting. Paper on "Fire Extinguishment by Mechanical and Other Means, including Sprinkler Installations," by Mr. J. T. Clarke.

NOTES.

Electrolytic Calcium.—At the annual general meeting of the Institute of Metals, on March 9th, a paper was read by Mr. P. H. Brace, of East Pittsburg, U.S.A., in which he gave a brief historical survey of the development of the metallurgy of calcium and described a type of apparatus developed by him for the manufacture of the metal, which is obtained by the electrolysis of fused calcium chloride. The electrolyte is first melted by means of an alternating current; when a small pool has been formed, direct current is switched on, and as the metal deposits on the cathode, the latter is slowly withdrawn from the bath. Further deposition takes place on this calcium, which itself is withdrawn at such a speed that a continuous rod of the metal is formed. A summary of the more important uses of calcium, including the preparation of certain aluminium alloys, is given in the paper.

Directional Wireless at Sea.—Marconi's Wireless Telegraph Co., Ltd., has brought to our notice the case of the crew of the British steamship *Fanad Head* which was recently instrumental in rescuing the personnel of the Norwegian steamer *Ontaneda* in the North Atlantic, off Newfoundland, when all hands would have been lost but for the use of the new wireless direction-finding apparatus. A heavy gale had left the *Ontaneda* drifting helplessly with broken-down engines, and a list of 50° in a heavy sea. Her captain sent out "S O S" signals for help, but in the thick weather he could get no observations of sun or stars, and had to estimate his position by dead reckoning. His calculations proved to be 90 miles out. Whilst several vessels which went to his assistance were steaming about near the position given without finding a trace of the *Ontaneda*, the *Fanad Head*, by means of her Marconi direction-finder, discovered the true position of the doomed vessel. She was nearer to the *Fanad Head* than to the ships which had originally steamed to her assistance, and Captain Finlay proceeded to the spot where he calculated the *Ontaneda* to be. The wireless direction proved to be the correct one, and the distressed sailors were rescued just in time.

Safety First!—According to the N.E.L.A. *Bulletin*, the Safety Committee of the Northern States Power Co. of Minneapolis is waging a vigorous campaign in the interests of safety. The Committee is not only bringing the attention of the employés to the dangers which exist in their work, but is also drawing attention to risks encountered while going to and from work and ways of guarding against them. Bulletins are issued each month to drive the safety message home to the employés. One of these gives the following :—

FAMOUS LAST WORDS.

"I wonder if it's alive? I'll touch it and see."
"Listen! That's the train whistle. Step on it and we'll try to get across."
"They say these things can't explode. I'm safe lighting this match."
"I wonder whether this rope will hold my weight?"
"I don't need rubber gloves to pull this dead wire out."

Problems of Unemployment.—In the *Journal* of the Royal Society of Arts for March 11th a paper on this subject, which was read before the Society on February 8th, by Mr. E. C. de Segundo, A.M.Inst.C.E., is printed.

The author points out that the problem of unemployment has descended to us from the remotest antiquity, and is of world-wide interest; every country is vitally in need of commodities which it cannot produce, yet unemployment threatens to increase throughout the whole world, except in Germany. Capital and Labour are in themselves inert (though necessary) factors in the production of wealth; the vitalising factor is directive ability, which is a form of capital owned by every intelligent being. Present-day unemployment is due to the rise of prices of commodities beyond the purchasing power of consumers, and increase of production will not, of itself, reduce our unemployment—the commodities produced must be offered at a price that will compete with that at which other producers offer them. The author condemns the continuance of the E.P.D. after the war as a disastrous error on the part of the Government, which led to economic instability and withdrawal of credit from industry.

Labour also is to blame for lack of foresight, and the discouragement of efficiency. Incidentally, the author points out that "a tax of 6s. in the £ on *earned* income is virtually the equivalent of *two days' forced labour per week*." Key industries should be permanently protected from foreign competition, and research should be encouraged. With regard to the reform of social conditions, while Socialism is a beautiful ideal, it has always failed in practice; the only thing that will prevent social disintegration is the more rigid observance of the moral law, which should be inculcated by a rational system of education. Both workers and employers have failed to appreciate the situation, and the remedy for their failure lies in their getting to know one another better. Every worker, in whatever class, should first qualify as a citizen; he should be rewarded in proportion to the services he renders, and the scale of remuneration should be based upon the character, as well as the extent, of his services; these conditions fulfilled, the industrial army is analogous to the military army, and should be maintained during slack periods by some form of insurance; but this industrial army should be confined to *British* working men. The Trade Unions should insist upon the maintenance of a proper standard of efficiency, ability, and moral character as a condition precedent to membership. To cope with the perils of the day, we should disperse the atmosphere of mistrust between employer and employed; condemn the abuse of confidence in trade; enforce the law against perjury; and foster the dissemination of sound, healthy moral principle.

In the discussion, the chairman (Mr. G. J. Wardle) pointed out that the author's proposed "industrial army" constituted a revolution in industry—a revolution which the Labour Party had proposed in the "Right to Work" Bill.

Mr. John Baker denied that Labour had abused its power with regard to wages during the war; prices went up, and wages followed prices.

Prof. J. A. Todd ascribed the trade slump to the beginning of the fall in prices a year ago, which caused consumers to hold back for a further fall. The "industrial army" system opened the door to obvious abuses. Mutual knowledge between employer and employed would go far towards producing a friendly settlement.

Educational.—Prof. J. A. Fleming, M.A., D.Sc., F.R.S., is to deliver a course of six lectures, commencing on April 27th, on "Wireless Telegraphy and Telephony by Continuous Waves." The lectures are to be given at University College, London, and the course is open to both members and non-members of the University. The fee is two guineas, and tickets can be obtained from Dr. W. W. Seton, University College, Gower Street, W.C. 1.

New Electrical Caulking Apparatus.—M. Gunnar Nord, the Stockholm shipbuilder, has invented a new electrical apparatus for caulking ships and houses, which carries out the work entirely automatically and in a tenth or fifteenth part of the time required to perform the same operation by manual labour. The invention is being exploited by the Stockholm lawyer, M. Herman Sundins.—*Reuter's Trade Service* (Stockholm).

Water Power in Italy.—Under the auspices of the University of London, a series of six advanced lectures is being delivered by Prof. Luigi Luiggi, D.Sc., M.Inst.C.E. (Professor of Hydraulic Construction in the University of Rome), upon "Recent Engineering Works in Italy." On March 11th the lecture was devoted to a description of hydro-electric construction. Prof. Luiggi said that prior to the war the aim of Italian hydro-electric engineers was to secure large volumes of water rather than high heads. During and since the war, however, the necessity for economising in materials led to the adoption of higher pressures and the use of smaller pipes and turbines. To-day, heads of 2,500 ft. were of common occurrence, and there were many installations in which a head of 3,000 ft. was in use. Hydro-electric plants, in the face of low interest obtained from Government bonds, &c., were considered a good and sound investment yielding 6 or 7 per cent. regularly. Hydro-electric power was an absolute necessity to the economic life of Italy, owing to the price of coal being from 15 to 20 times the pre-war rate. Most coal-using works, blast furnaces, &c., had been forced to shut down, and this led to the reaping of a rich harvest by users of electric furnaces. The lecturer gave numerous details regarding the rainfall and other factors in various districts of Italy, and described the construction of canals, dams, and pipe lines, illustrating his remarks with a large number of excellent lantern slides. Apart from their efficiency, these works conform to the canons of architecture; as the speaker said, when millions of lire have been spent upon construction, the engineers feel that the expenditure of another half-a-million lire, to secure a certain amount of beauty, is not waste.

The lectures, which are being held at the Institution of Civil Engineers, conclude to-day.

The Proposed Engineers' Club for London.—Since the meeting of the Provisional Committee on February 10th, the Executive Committee which was then appointed has been considering the questions of rules and membership, housing and finance, with a view to placing concrete proposals before a general meeting of the supporters of the scheme, which will be convened when the Committee's report is ready. In the meantime there is no slackening in the interest manifested in the subject by prospective members; the number of applications received by Mr. Edmund L. Hill, hon. secretary (39, St. James's Street, S.W.1), has long passed the thousand mark. It is very desirable, for the guidance of the Committee, that everyone who contemplates joining the Club should signify his intention as soon as possible. A provisional application form has been printed, and is being widely distributed; we suggest that those who intend to become members should each obtain a supply of these from the hon. secretary, with a view to securing the adhesion of their engineering friends to the scheme.

Hydro-Electrotechnics in France.—The city of Toulouse has signed an agreement with the University to place at the disposal of the latter the falls of the Baulève on the Garonne; a large area of land near the Castle has also been placed at the disposition of the University for the purpose of setting up a hydraulic industrial laboratory. The building will be erected so as to serve as a permanent exhibition or museum of hydraulic technics. This institution will have a beneficial influence throughout this region of France. The Electrotechnical Institute of Toulouse has made an agreement with the Société Hydrotechnique de France, whereby the work of carrying out tests of the hydro-electric stations in the Pyrenees and the region of the Massif Central will be done by the Institute. The Minister of Public Works has also committed to the same Institute the execution of important hydraulic researches. These commissions render indispensable the erection of a laboratory with available hydraulic energy and a considerable quantity of water. The Toulouse Hydroelectric Institute was founded in 1907 and has at its head Prof. Carmichel.

Water-Power in the United States.—A proposed plan to develop about 500,000 kW in water-power on the Delaware River, at a total cost estimated at $200,000,000, has been announced by Mr. Paul T. Brady, of the Westinghouse Electric and Manufacturing Co. Active work will be commenced as soon as authorisation is received from the Federal Water Power Commission. The plan calls for the construction of four dams, with an average head of 80 ft. The total power capacity of these dams is estimated at about 500,000 kW at normal high water. In addition a steam-power plant with a capacity of 100,000 kW will be erected somewhere in New Jersey in order to supplement the hydro-electric plants during seasons of low water. If present plans are carried out, the steam-power plant and two of the hydro plants will be in operation by January 1st, 1923.

Applications for permission to use water power filed with the Federal Power Commission at the end of January numbered 168, totalling 16 million h.p., of which 2½ millions were in conflict, leaving a net total of 13½ millions. The power involved is about 27 per cent. of the estimated maximum potential water power of the country and 57 per cent. of the minimum. By far the largest project is that of the Southern California Edison Co. in the Grand Canyon of the Colorado River, in three stages, aggregating 3½ million h.p.

Electricity as Scapegoat.—A correspondent of the *Electrical World* protests against the common practice of attributing fires which occur in buildings in which electricity is installed, to "crossed wires." The writer states that he knows of a case where this reason was assigned to an outbreak of fire when the affected building was not wired at all. There is also a tendency to ascribe fires in this country to electricity, when the cause is not apparent. The practice is grossly unfair.

New Copenhagen Atomic Research Institute.—On March 3rd a new section of the Danish University was opened, under the title of the Atomic State Institute, for the study of atoms as distinct from the study of experimental physics, now being carried on at the Technological Academy. Prof. Niels Bohr, Principal of the Institute, explained that ways would be opened for entirely new research and, pressing an electric button, he disclosed an arrangement by which the colours of the spectrum were projected from a platinum wire through plates of glass. It was, he said, by means of these colours that the secret of atoms was being studied. The Rector of the University spoke of the Institute as a model organisation in international science.—*Birmingham Post.*

Hydro-Electric Works in Bavaria.—The conclusion has now been reached by the Government of Bavaria that it will be impossible to bring to a conclusion the proposed Bayernwerk—one of the State works for the supply of electricity in Bavaria—without also having recourse to private capital. It is estimated that the expenditure on this hydro-electric works would amount to 500,000,000 marks under existing circumstances, which sum it would be impossible for the State to raise. As a consequence, a Bill is about to be laid before the Bavarian Diet to authorise the conversion of the Bayernwerk into a joint stock company, with a share capital of 100,000,000 marks, which will be fully subscribed by the State, while the amount of 400,000,000 marks is to be issued in the form of a loan to be guaranteed by the State. The loan is to be raised on the same terms as the loan issued for the Walchensee works and the middle Isar, and the hope is entertained in Government circles that the emission will find a favourable market, provided that the company is formed as quickly as possible.

Service Notes.—As a temporary measure, until sufficient submarine detector ratings have been trained, says *The Times*, the Admiralty announces that wireless ratings may be employed on hydrophone duties in submarines "as a special case." The ratings selected will be given a short course of hydrophone instruction at Portland, and may receive the allowance of 3d. a day as detectors, second class, while actually employed in submarines as qualified listeners.

The Supplementary Admiralty Orders for March, issued on the 12th inst., show that a revised scheme for the Royal Naval Reserve and the Royal Naval Volunteer Reserve has been approved. The latter, says *The Times*, will be composed of seamen, signalmen, wireless telegraphists, engine-room, electrical, and ordnance artificers, motor mechanics, artisans, writers, and victualling ratings. Enrolment in the R.N.V.R. will be for four years, and during that period every rating will do 42 days' training, including 14 days at sea. Pay, when called out or during training, will be that of the corresponding ratings in the R.N., and marriage allowance will be made. Certain bounties for out-of-pocket expenses will also be allowed.

Electric Supply Cricket League.—We are asked to announce that it is hoped to start matches in connection with the Electric Supply Cricket League during the forthcoming season. The League is confined to electricity supply undertakings within 10 miles of Charing Cross. Full particulars regarding membership, &c., can be obtained from Mr. A. W. Seabright, the hon. secretary, at 19, Cadogan Gardens, S.W.

The League had to suspend its activities during the war, but it is hoped that there will be an accession of clubs to the League this season.

Appointments Vacant.—Relief charge engineer and junior charge engineers, for the Newport Corporation Electricity Department; permanent way foreman, for the Colombo Electric Tramways and Lighting Co.; shift engineer, for the Doncaster Borough Electricity Department; charge and shift engineer, for the Borough of Trent Electricity Department. See our advertisement pages to-day.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Summer Meeting.—We have already announced that a summer meeting of the Institution will be held at the Scottish Centre (at the invitation of the Committee of that Centre, of which Mr. J. E. Sayers is chairman), from June 7th to 10th, and we are now able to outline the provisional programme. On Tuesday, June 7th, a visit will be paid in the morning to the Corporation generating station at Dalmarnock, preceded by a paper by Mr. R. B. Mitchell, describing the station. In the afternoon visits will be paid to the shipyard of Messrs. John Brown & Co., Ltd., Clydebank, to the Clydes Mill power station of the Clyde Valley Electric Power Co., and to other works; there will also be an excursion by road to some of the Glasgow Corporation's reservoirs. In the evening a public function will be held at Glasgow. On Wednesday morning, June 8th, a paper will be read at Glasgow University, by Prof. Magnus Maclean, on "The Hydro-Electric Resources of the Scottish Highlands." During the first part of the afternoon the works of Messrs. Babcock & Wilcox, Ltd., at Renfrew, will be visited, after which, by the invitation of the firm, an excursion by steamer on the Firth of Clyde will occupy the rest of the afternoon and evening. The last two days of the meeting will be devoted to a West Highland excursion; on Thursday, June 9th, a start will be made from Glasgow, at mid-day, for Fort William, where the night will be spent, and next morning, Friday, June 10th, members will proceed by steamer to Kinlochleven, where the British Aluminium Co.'s hydro-electric installation will be inspected. A return by steamer during the afternoon to Oban will conclude the meeting.

Ladies are cordially invited to take part in the meeting, and application for tickets should be made to the Secretary of the Institution, 1, Albemarle Street, W. 1, not later than March 28th.

Magnetic Susceptibility of Low Order.—Prof. E. Wilson delivered the last of his lectures (see p. 246 of our February 25th issue) on the above subject to the members of the Institution on the 10th inst.

III. *Practical Applications.* — At the present time so far as actual bulk is concerned magnetite is of the first importance, but magnetic separation has found applications in other directions. In 1914, in Northern Norway, about 2,200,000 tons of ore were dealt with, yielding 900,000 tons of concentrates. At Mineville, New York State, U.S.A., about 1,200,000 tons of ore were dealt with in 1916, and in 1917 in Sweden 2,500,000 tons of ore, yielding 1,100,000 tons of concentrates, were recorded. Of course, these figures do not refer to such important applications as the separation of wolfram from tinstone ores, or the separation of monazite for use in the gas mantle industry.

The lecturer exhibited tables giving the susceptibility values of minerals to be separated, together with those which are important and most likely to be met with.

The susceptibility of even low-grade magnetite, which may be of the order 0·1, is still so high as to overwhelm that of any other rocks. It is largely associated with apatite, which has a small negative susceptibility and which gives rise to trouble, not from a magnetic standpoint, but because it takes the form of an impalpable powder and adheres to the magnetite most tenaciously. Its removal has to be specially dealt with by washing or by air-blast, as the case may be. In the separation of wolfram ore from tinstone there is none too large a margin in favour of the wolfram ore. A great field is open for treatment.

The deposit in which monazite is found contains amongst other minerals ilmenite and zircon. This is a case of double separation, the ilmenite being extracted by a weak field, and the monazite by a strong field, the zircon going forward as a non-magnetic mineral. Great care must be taken, if grinding of the ore has to be resorted to, that the zircon, which is very hard, is not rendered magnetic by minute traces of iron.

In the separation of spathic ore from zinc-blende or copper pyrites, there is a fair margin in favour of the former, and there is scope for treatment.

The separation of franklinite from zinc-blende was one of the early problems solved by Wetherill. Specular ore when occurring with magnetite, as in the Norwegian schists, involves a double separation, the magnetite being first removed by a weak field, and the hematite by an intense field.

A great deal of ingenuity has been spent upon the construction of the machinery used in magnetic separation. In the case of magnetite, the preliminary rough dry process (Wenström or Gröndal) is followed by either a dry or wet fine separation. The Edison separator is an example of the dry process, and that of Gröndal is extensively used in wet separation. In the case of feebly magnetic materials, *e.g.*, monazite, the double separators of Wetherill, the Rapid Magnetting Machine Co., or Humbolt, are available.

Wireless Section.—At a meeting of this Section of the Institution on March 16th, a paper by Mr. G. Stead, M.A., on the "Effect of Electron Emission on the Temperature of the Filament and Anode of a Thermionic Valve," which was communicated by Prof. Sir J. J. Thomson, described experiments which were carried out in the Cavendish Laboratory in May, 1918, and which were undertaken on behalf of the Wireless Telegraphy Department of H.M. Signal School, Portsmouth. The paper, which was published with the consent of the Admiralty, explained that the temperature at any point on a tungsten filament which was emitting electrons was altered by the passage of the emission current through the filament, and also on account of the latent heat of evaporation of the electrons. An account was given of some direct measurements, made with an optical pyrometer, of the distribution of temperature along an emitting filament under various conditions, and it was found that when the negative end of the anode battery was connected to the negative end of the filament battery the distribution of temperature along the filament became increasingly unsymmetrical as the emission current increased, the negative limb being hotter than the positive limb at a given distance from the lead. In the particular filament employed in the experiments it was estimated that the total electron current from the filament increased by 35 per cent. when the emission amounted to 11 per cent. of the current from the filament battery. An account was also given of some measurements of the temperature of an anode which was undergoing electron bombardment, showing the relation between the anode temperature and the number of watts dissipated by the anode per sq. cm. of surface.

At the same meeting Dr. W. H. Eccles, vice president, and Miss W. A. Leyshon, B.Sc., presented a paper dealing with "Some Thermionic Tube Circuits for Relaying and Measuring," the first part of which was concerned with some methods of measuring the voltage factor of a triode, and with circuits arranged for voltage amplification in which the full value of the voltage factor could be utilised. In the ordinary method of using a triode as a voltage amplifier, a high resistance was included in the anode circuit, and the variations in the p.d. across the resistance resulting from variations in the grid potential were utilised. The authors showed that a diode could replace the resistance or impedance in a voltage amplifier, with a resulting increase in the sensitiveness of of the latter. The second part of the paper dealt with some methods of detecting very light contact between two conductors; and the third part described triode circuits in which very small movements of a conductor could be made evident. It was pointed out that the experiments recorded in the second and third parts of the paper might form the basis of relays which could be actuated by extremely feeble currents or slight movements of conductors; the possibilities of the apparatus were many, and it might add appreciably to the ever-growing variety of uses to which the thermionic valve might be put.

Barrow and District Association of Engineers.—At a meeting of the Association on March 11th, Mr. T. A. Sedgwick, A.M.I.E.E., read a paper on "Electric Furnaces." He said that the war was responsible for an enormous increase in the number and tonnage of electric furnaces in each of the countries affected. Previous to 1914, the greater part of the alloys were imported, and when those supplies were interrupted, the steel manufacturers were compelled to take up their production. At the time of the armistice, their yearly output of alloys exceeded 10,000 tons, an output which met the whole country's requirements. It could be said that the number of furnaces installed in this country was not less than 150 with an aggregate capacity of 120,000 kVA.

Edinburgh Electrical Society.—At the Apprentices' Night, held on March 11th, competitive papers were read by Messrs. Bee, Clunie, and Mercer, the respective subjects being "Measuring Instruments," "Small Motors," and "Country-House Lighting." The papers were much appreciated, and the decision as to prize will be announced later. At the next meeting of the Society, to be held on March 25th, Mr. Leithead will give a lantern lecture on "Automatic Telephones."

Chelmsford Engineering Society.—On March 3rd, Mr. L. D. Hill read a paper on "Direction and Position-Finding by Wireless." The author dealt with the history and principles of direction finding in detail, the lecture being fully illustrated by numerous lantern slides and a film showing a demonstration of position-finding from three land stations during an aeroplane flight from London to Brussels. Reference was made to the very important part played in the war by British direction-finding, which far surpassed the efforts of enemy countries.

Institution of Railway Signal Engineers (Inc.).—The next meeting will be held at the Midland Grand Hotel, St. Pancras, on March 23rd, when a paper by Mr. D. C. Gall, entitled "Fundamental Calculations of a.c. Track Circuits" will be read and discussed.

Manchester Wireless Society.—At a meeting, on February 23rd, Mr. P. G. Thomason, late of the Royal Naval Reserve, lectured on "Aerials." After explaining the purposes of an aerial, and describing the early designs of Hertz and those of Sir Oliver Lodge, and the long vertical wire of Marconi, the lecturer enumerated the types of aerial in use to-day. The directional effect of aerials was explained, and the types of aerials in use at the big wireless stations, such as Clifden, Poldhu, and Carnarvon, were described in that connection.

Royal Artillery Institution.—Mr. H. F. Trewman, chief instructor in the electrical branch of the Ordnance College, lectured, by the aid of diagrams and lantern slides, on "Wireless Telephony," at the above-named Institution, at Woolwich, on March 8th.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Fulham Borough Council Electricity and Lighting Committee recommends that the basic salary of Mr. N. A. Chesterfield, chief clerk in the electricity department, be increased as from April 21st from £230 to £275 per annum, which, with the cost of living adjustments under the scale of the National Joint Board, will temporarily increase his total remuneration to £476 per annum.

Mr. F. G. Nesbitt has been appointed by Carron Company as its representative for London and the Southern Counties for its electric cooking and heating department, in succession to Mr. C. McKinlay, who has left its service.

Mr. W. J. Green, for 11 years manager at Weston-super-Mare for the Bristol Tramways Co., who is leaving, has been presented by the clerical staff with a silver-mounted umbrella, and by the traffic staff with a silver inkstand.

Messrs. William C. Yuille & Co., Ltd., of Glasgow, electric fittings suppliers, have appointed Mr. A. Munro (of the Edison Swan Electric Co., Ltd.) as manager. He will combine with the appointment the duties of the late Mr. H. D. Anderson, director.

We are informed that Mr. Walter Rutherford has resigned from the board and management of the English Electric Co., Ltd. Mr. P. J. Pybus, joint managing director, has been appointed managing director.

Obituary.—Mr. J. Cameron.—The death has taken place, at the age of 72 years, of Mr. John Cameron, of Bispham, near Blackpool, who, until the Blackpool Corporation took over the undertaking last year, was manager and secretary of the Blackpool and Fleetwood Tramroad Co.

Mr. W. E. Dalgleish.—The many friends in the North of England of Mr. W. E. Dalgleish will regret to hear of his death on March 10th. He was employed for many years by the Metropolitan-Vickers Electrical Co., Ltd., and during the past eight years as one of the engineers on the erection staff attached to its Newcastle-on-Tyne district office.

NEW COMPANIES REGISTERED.

Macqueen's Standardised Aluminium Alloys, Ltd. (173,553).—Private company. Registered March 7th. Capital, £100 in £1 shares. To acquire the manufacturing, utilising, exploiting, and selling rights in the United Kingdom or elsewhere of a process of standardising the alloys of aluminium invented by L. E. Macqueen, and known as "Macqueen's Standardised Aluminium Alloys." The first directors are: L. E. Macqueen, 6, Arthur Street, W.C. 2, consulting metallurgist and analyst (permanent managing director); L. A. Macqueen, 43 Munster Square, Regent Park, N.W. 1, electrician. Registered office: 267, High Holborn, W.C. 1.

Waterloo Tool Co., Ltd. (173,558).—Private company. Registered March 7th. Capital, £2,000 in £1 shares. To carry on the business of manufacturers of and dealers in tools and cutlery, electrical and mechanical engineers, electricians, &c. The subscribers (each with one share) are: F. V. Lippold, 11, The Grove, Wandsworth, S.W., electrical engineer; W. A. S. Oxborow, 18-20, Temple Chambers, E.C., accountant. F. V. Lippold signs as "director." Registered office: 21 and 23, York Road, Lambeth, S.E.

C. F. Elwell, Ltd. (173,566).—Private company. Registered March 8th. Capital, £50,000 in £1 shares (40,000 "A" ordinary and 10,000 "B" ordinary). To adopt agreements with C. F. Elwell; to carry on the business referred to therein; to acquire the benefit of and turn to account inventions relating to radio telegraphy, telephony, and other means of intercommunication, and apparatus, instruments, and appliances connected therewith, &c. The subscribers (each with one "A" ordinary share) are: B. L. H. Diddams, 117, Fortress Road, N.W. 5, clerk; A. E. Fournier, 24, Gosberton Road, S.W. 12, clerk. The directors are to number not less than two nor more than six. The Radio Communication Co., Ltd., and C. F. Elwell (or his representatives) may, so long as they respectively hold £5,000 shares, nominate two directors each. The first directors are: J. H. Scrutton and E. Benyon (deemed to represent the said company) and C. F. Elwell and E. E. Mittell (deemed to represent the said C. F. Elwell). Registered office: 12, Craven House, Kingsway, W.C. 2.

R. G. Co., Ltd. (173,555).—Private company. Registered March 7th. Capital, £125 in 6d. shares. To acquire and deal in patents and inventions relating to electrical and mechanical engineering, &c., and to acquire the exclusive British, Colonial, and foreign patent rights in an invention relating to reversing gears, for which provisional patent No. 29,636 of 1920 has been granted to F. Newton and Newton Brothers (Derby), Ltd. The permanent directors are: C. A. Newton, Park Lane House, Littleover, Derby; F. Newton, 9, Keddleston Road, Derby; R. Newton, 36, Ashbourne Road, Derby; H. Newton, Mile Ash House, Duffield Road, Derby; H. B. Roy, Darley Dene, Belper Road, Derby. Secretary: C. A. Newton. Registered office: 21, Market Place, Derby.

Marler & Co., Ltd. (173,489).—Private company. Registered March 3rd. Capital, £7,000 in £1 shares. To carry on the business of electrical, mechanical, and heating engineers and contractors, &c. The permanent directors are: W. S. Marler, Guyon, St. Julian's Avenue, Newport, Mon.; G. J. Fisher (chairman), Briarlea, Penygarn, Pontypool; C. D. Esnouf, Brookale, Pensisely Road, Llandaff; R. Fisher, Trouville, New Inn, Pontypool Road; R. Moore, Newport, Mon. Solicitor: H. Saunders, Pontypool.

Wye Lighting, Heating & Power Co., Ltd. (173,525).—Registered March 4th. Capital, £5,000 in £1 shares. To carry on the business indicated by the title. Minimum cash subscription £7. The first directors are: J. P. Sharples, 6, Upper Bridge Street, Wye, Kent; J. Long, 15, Church Street, Wye, Kent; S. D. F. Harwood, "La Quinta," Wye, Kent. The two first-named are permanent. Qualification £100. Secretary: F. Flower. Registered office: 7, Bank Street, Ashford, Kent.

Fogdens Electric Co., Ltd. (173,508).—Private company. Registered March 4th. Capital, £2,000 in £1 shares. To carry on the business of electricians, electrical, mechanical, sanitary, gas and water engineers, ironmongers, manufacturers of and dealers in automobiles, motor cars and bodies, &c. The first directors are: Mrs. Bertha Fogden (governing director), Prestatyn, The Cliffs, Southend; Miss Blanche Fogden, Prestatyn, The Cliffs, Southend. A. F. Wilson, Wynchmore, Crowstone Road South, Westcliff. Registered office: 23, The Broadway, Leigh-on-Sea.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Church Stretton Electric Supply Co., Ltd.—Charge on certain land and buildings at Crossways, Church Stretton, and Church Stretton Electric Lighting Order, 1916, rights, powers and privileges, &c., dated January 29th, 1921, to secure £1,550. Holder: Church Stretton Developments, Ltd.

Ebonestos Insulators, Ltd.—Satisfaction in full on January 31st, 1921, of mortgage dated June 30th, 1920, securing company's balance at bankers.

Marston Billington, Ltd.—Debenture dated February 19th, 1921, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: F. G. W. Pearson, Highlands, Farnham Common, Bucks.

Electrical Contracts & Maintenance Co., Ltd. (101,757).—Return dated December 31st, 1920. Capital, £3,000 in £1 shares. All shares taken up. £1,331 paid. £1,669 considered as paid. Mortgages and charges, nil.

Dartmoor Electric Supply Co., Ltd.—Issue on February 17th, 1921, of £1,050 debentures, part of a series already registered.

Colne Valley Electric Supply Co., Ltd.—Satisfaction in full on February 12th, 1921, of debenture dated December 2nd, 1915, securing all moneys due or to become due.

Northampton Electric Light & Power Co., Ltd.—Issue on February 12th of £1,000 and on February 23rd, 1921, of £2,200 second debenture stock, parts of a series already registered.

Tredelect Dynamos, Ltd.—First and second mortgage debentures dated February 22nd, 1921, to secure all moneys not exceeding £4,000 each, which the mortgagees may pay under their guarantee to company's bankers, charged on premises in Water Lane, Richmond, and the company's undertaking and property, present and future, including uncalled capital. Holders: Sir Herbert H. Bartlett, 56, Victoria Street, Westminster; F. A. Minter, Old Trees, Parkside, Wimbledon; and others.

C. H. Hare & Son, Ltd. (110,911).—Return dated December 31st, 1920. Capital, £16,000 in £1 shares (8,000 preference and 8,000 ordinary). All shares taken up. £8,502 paid. £7,498 considered as paid. Mortgages and charges, nil.

Henry Bisseker, Ltd.—Particulars of £6,300 second debentures authorised January 27th, 1921, whole amount issued, charged on the company's undertaking and property, present and future, including uncalled capital.

Leatherhead & District Electricity Co., Ltd.—Particulars of £10,000 debentures authorised February 7th, 1921, present issue £9,150, charged on company's property, present and future, including uncalled capital, subject to prior first mortgage debentures.

CITY NOTES.

W. T. Henley's Telegraph Works Co., Ltd.

The accounts for 1920 show a profit of £240,003. Deducting £46,975 for directors' and auditors' fees, debenture interest, and depreciation, and adding £141,633 brought forward, the total is £334,661. Income tax requires £45,524; reserve £18,432; loss on realisation of Government loans and trustee securities £35,681, less reserve, £5,607, plus £7,560 transferred to reserve against Government loans and trustee securities still held, making £13,166; preference dividend £9,000; interim dividend on the ordinary shares £20,000; pension funds £5,000; final dividend on the ordinary shares of 2s. per share, less tax, making 3s. for the year, requires £40,000; to be carried forward £183,538. Provision has been made in the accounts in respect of the liability for excess profits duty and corporation tax to the end of the year 1920. Henley's Tyre & Rubber Co., Ltd., has had a successful year's trading, and the progress of the company has necessitated an increase in the capital employed from £140,000 to £200,000 The Tyre Co., following the practice of the parent company of purchasing against requirements only, has been fortunate in not holding any considerable stocks of rubber, and has consequently been able to take full advantage of the fall in prices. Since the close of the year, an issue of £250,000 ordinary share capital at 24s. per share has been made. The applications considerably exceeded the amount offered. In allotting the shares preference was given to applications from the existing ordinary and preference shareholders and debenture stockholders, all of whom received allotment in full.

Newcastle and District Electric Lighting Co., Ltd.

At the annual meeting, held in Newcastle on the 11th inst., Lieut.-Col. F. R. Simpson, who presided, said that in view of the uncertainty of the outlook they had placed £16,000 to the general reserve. During the year capital expenditure had reached £23,065, necessary to meet the large increase in the demand for energy. A further £16,000 had been allowed for depreciation, making the amount written off up to date £105,500. Wages, salaries, coal, &c., showed an increase of £14,959, coal being the principal item. As to wages, rates of pay were nearly 170 per cent. above pre-war level. The total gross receipts for electrical energy supplied showed an increase of £36,937, or 33 per cent. over 1919, which was mainly due to a large increase in new consumers and extensions to existing installations. The net profit for the year was £11,104, making, with the amount brought forward from the previous year, an available balance of £24,367. During the year a petition was lodged against the Newcastle Corporation Bill, which contained clauses conferring upon the Corporation powers to supply electrical energy to consumers near its tramways, and which would have affected the rights of the company. As a result of the petition the clauses referred to were deleted. It was resolved that a dividend at the rate of 5 per cent., less income tax, be paid for the year.

Para Electric Railways and Lighting Co., Ltd.

At the meeting held last week, Mr. Follett Holt said that the situation in Para was adversely affected by the sudden and serious fall in the exchange value of the Brazilian milreis from the high figure of 18d. to little more than half that figure. The important bearing thereof on their revenue had caused them to be very conservative in the allocation of their funds, and in the recommendation to reduce the dividend from 8 per cent. to 6 per cent. for 1920. The local gross receipts were slightly less than the year before, chiefly owing to certain concessions made both for public and private lighting in connection with the debt settlement; during the latter part of the year traffic returns were less satisfactory, due to the state of the rubber market. The general condition of the rubber market, chiefly governed, of course, by the Eastern plantation rubber, was critical, and there was little doubt that the year 1921 would put the commercial endurance of Para and its hinterland to a severe test. The outlook in respect of the company's local earnings was not encouraging, and operating and other expenditure had to be carefully watched.

County of London Electric Supply Co., Ltd.

Capital expenditure during 1920 £293,821. Revenue for 1920, after deducting expenses, &c., £244,253, plus £19,188 brought forward. Debenture interest, less tax, £53,751; written off preliminary expenses £8,972; to reserve for depreciation, renewals, &c., £50,000; to general reserve £62,500; 6 per cent. on preference shares, less tax; 8 per cent. for the year, less tax, on the ordinary; carried forward £18,595. The death is recorded of Mr. F. E. Savory, one of the original directors of the company. Sir Ernest Hiley resigned from the directorate in August last, and Sir Guy Granet in December, due to increasing pressure upon their time. Lord Gainford and Lieut.-Col. Sir Frederick Hall have been appointed to the board. The deputy chairman, Sir Harry Renwick, has been appointed chairman and managing director. In order to comply with the requirements of the new Electricity (Supply) Act, 1919, application was made early last year to the Electricity Commissioners for their consent to the company proceeding with the erection of its proposed generating station at Barking, powers for which were obtained in 1913. The Commissioners decided to defer

this matter until after March 31st, 1921, by which date schemes have been invited by them covering the constitution of a Joint Electricity Authority for the London and Home Counties Electricity District. An extraordinary general meeting has been convened at the conclusion of the ordinary general meeting for the purpose of considering, and, if thought fit, approving a Bill introduced by the company for the purpose of facilitating the erection of the proposed generating station at Barking, in the event of the consent of the Electricity Commissioners being obtained. The applications received during the past year amounted to the equivalent of 5,678 kW, making the total at December 31st last 87,902 kW. Consumers have increased from 31,390 to 34,764. As to the associated companies, the South London Electric Supply Corporation, Ltd., has declared a final dividend on the ordinary shares at the rate of 9 per cent. per annum, making 7 per cent. for the year. The Bournemouth & Poole Electricity Supply Co., Ltd., has declared a final dividend on the ordinary shares at the rate of 9 per cent. per annum, making 7 per cent. for the year. The business of the Coatbridge and Airdrie Electric Supply Co., Ltd., continues to progress. Units generated and purchased, 66,926,800; total sold, 49,553,223 (increase 7,065,551); used on works, 6,098,029; used in transmission and distribution, 11,275,548. Meeting held March 15th.

Allmaenna Svenska Elektriska A.B.

The report of the Allmaenna Svenska Elektriska A.B., of Vasteras, states that the directors experienced great difficulties in planning the company's activity during 1920. In the first half of the year manufacturing did not correspond by a long way to the great demand for the company's products, while the new orders coming to hand at the end of the year, particularly from the Scandinavian markets, showed a large reduction. The present stock of orders was certainly satisfactory, but the company would be unable to avoid having to manufacture for stock to a large extent. The results of the year's activity were prejudicially affected by two strike months at the beginning of the year and by prices falling heavily. The directors were adopting strong measures to reduce the stocks and the working expenses.

The department for electrical installations was satisfactorily occupied, although in this branch also the orders seemed to be decreasing. The sale departments in Sweden had been reorganised in order to bring down the high working expenses which were occasioned by the late period of high prosperity, and in connection with this matter the sale of installation materials had to the greatest possible extent been concentrated at the company's central warehouse in Stockholm. Satisfactory results were being shown by the export trade, and the new markets to the westward were constantly being increased. A new subsidiary company was started in Belgium at the change of the year with a share capital of 500,000 kr. During the year negotiations were opened with the Soviet Government regarding a concession to carry on business in Russia, and the discussions were still proceeding.

The activity at the ironworks departments was still further diminished on account of the inconsiderable demand. Mining operations were suspended during the year after sufficient ore for treatment in the near future had been mined. The production of pig iron was being continued to a reduced extent; the new sheet rolling mill at Surahammar had been brought into operation, and was supplying transformer sheets of high quality for the company's needs. At the end of the year the number of persons employed at the company's own offices and works was 6,963, as compared with 7,220 at the close of 1919.

After having made provision for depreciation, interest charges on loans, and for taxation, the accounts show net profits of 4,018,000 kr., as contrasted with 8,019,000 kr. in 1919 and 7,718,000 kr. in 1918. As mentioned in a previous issue, the dividend is at the rate of 6 per cent., as compared with 12 per cent. in 1919, leaving 337,000 kr. to be carried forward. The share capital now amounts to 108,500,000 kr., as against 84,050,000 kr. in 1918. In addition the company's own loans amount to 10,000,000 kr., while the debt to the banks increased from 378,000 kr. in 1919 to 5,849,000 kr. last year.

Telegraph Construction & Maintenance Co., Ltd.

Presiding at the annual meeting, on March 10th, the Earl of Selborne, K.G., said that on the debtor side of the balance sheet the debts owing by the company and reserves for insurance and contingencies had increased by no less than £436,843, as compared with the previous year, and stood at the large figure of £1,882,550. On the asset side the item of stocks of stores, materials, &c., showed a corresponding increase of £832,122, and stood at £1,551,978. On the one side the figures were due to the company having received large sums as instalments on account of contracts in course of being carried out, and on the other to the unusually heavy stocks of materials and cable forming part of those unfinished contracts. The profit and loss account showed a net profit, after providing for income tax, excess profits duty, and corporation tax, of £110,187, which was about £14,000 less than last year. It must be remembered that a year ago the prices of materials were on the upward grade, whereas now they were rapidly falling, and it was very difficult to maintain prices on a falling market. As instances he might mention that iron wire had fallen about £20 a ton, steel nearly £30 a ton, copper wire about £50, and jute yarn about £60 a ton. Those reductions had mostly taken place in the last few months of the year. The responsibility and anxiety of the management of such a business as theirs during a year like 1920 had been very great, and they had reason to be very grateful for the skill which had been shown. Before the close of the year they purchased the ex-German cable steamer *Stephan* from the Ministry of Shipping. They realised that the present was not a favourable time to buy a steamer, but they had certain contracts for which she was required, and there was no other course open to them. As showing the unprofitable nature of shipowning at the present time, he might give them the receipts and expenses of their three steamers last year. The *Colonia* brought in receipts amounting to £181,859, and her expenses were £182,626, a loss of £1,067. The *Stephan* brought in £166,904, against expenses amounting to £168,167, an excess of expenditure over receipts of £1,263. In the case of the *Telcona* the receipts were £49,794 and the expenses £45,940, a profit of £3,854. Those figures showed that in a year in which their ships had been fully employed, they had been unable even to earn their depreciation. It was obvious that operating expenses must come down or their ships would have to join the ranks of the unemployed; they could not continue to contemplate a loss on every voyage they undertook. He hoped sincerely that this year they would get back to an economic basis in that regard. Out of the £110,187 profit for the year they proposed to pay the shareholders in dividends a total of £89,640; to add £20,000 to the reserve fund, and to increase the carry forward by £547. Before arriving at that profit they had had to provide for income tax, excess profits duty, corporation tax, and rates and taxes of their works, an amount of over £130,000, which was very much more than the shareholders received in dividends, and during the year they had paid over half a million sterling in wages and salaries. In that connection he would like to draw their attention to the great drag on industry caused by the rising rates. At their two works, owing to the rise in the assessments and the great increase in the rates, they would this year have to pay about £19,000 in that way, as compared with £2,600 in 1900. When they took everything into consideration the results of the past year were satisfactory. The country was passing through a time of most extraordinary difficulty. There was no royal road out of the economic position in which they found themselves. They could only emerge by rigid economy and by a lessening of taxation. What the world wanted was peace—an assurance of peace by the settlement of disputes among nations, and the consequent resumption of international trade. That alone would bring them a new era of prosperity.

Metropolitan Electric Supply Co., Ltd.

At the annual ordinary general meeting held on March 8th, Mr. A. W. Tait, C.B.E. (chairman), said that the increase in revenue for the year was satisfactory as the two previous years showed a slight decrease. The output rose from 25,127,000 to 27,798,000 units. The removal of restrictions had had a beneficial effect upon the lighting load, and the number of new consumers connected represented an addition of 3,374 kW. The present trade depression necessarily had an adverse effect upon the sale of power, but the company was really well situated as there had been considerable industrial development in its western area of supply, leading to a number of new connections. It was hoped that the new plant at Willesden would be available before the end of the year; this should enable the company to effect considerable economies in generation and distribution. It was necessary to raise £500,000 in order to carry out the programme of the company. Negotiations already had been opened in this direction, and it was thought that the investment would prove an attractive one, having regard to the sound position of the undertaking. The chairman thought that the next directors' report would be very satisfactory, as the peak of high prices had been passed. The report and accounts were adopted.

Charing Cross, West End and City Electricity Supply Co., Ltd.

The ordinary annual meeting of the shareholders was held on March 10th. Mr. Wm. F. Fladgate, M.V.O. (chairman), who presided, said that the output had reached 14¼ millions of units in the West End and over 20 millions in the City. Referring to the borrowing of £250,000 on 6½ per cent. secured notes, the chairman said that it had been the practice of the company to depend on advances from its bankers, but owing to the contemplated large expenditure it was thought wiser to raise the necessary funds by the issue of the notes. A large part of this amount (£160,000) had been spent upon works at Bow, but until December last the improvements were not benefiting the company, although it was hoped to realise a marked decrease in costs later in the present year. The speaker hoped that from £100,000 to £150,000 would suffice for the capital expenditure this year, but this would depend upon the cost of labour and materials. The directors were asking for increased borrowing powers to the extent of £250,000 for each undertaking—City and West End. These powers were required, as the limit of the present powers had almost been reached. The chairman spoke at some length upon the proposed Greater London electricity supply scheme. He stated that the supply companies had produced a scheme, in which the L.C.C. participated, and the engineering proposals

had been found satisfactory to both parties. For various reasons the preparation of a joint financial scheme was considered undesirable, and separate schemes had been formulated. The report and accounts were adopted, and the resolution empowering the board to borrow £500,000 was passed unanimously.

Newcastle-upon-Tyne Electric Supply Co., Ltd.

During the year 1920 the connections increased by 25,203 h.p. to 341,940 h.p. The profit was £392,643, against £248,194. After deducting £30,000 for plant renewals and improvements reserve, and adding £9,598 brought forward, there is available £372,242, against £259,621. Debenture and loan interest require £57,914 and reserve for special depreciation and contingencies other than the equalisation of dividends £25,000; dividends on the 7 per cent. cumulative preference shares and the 5 per cent. preference shares are paid, subject to income tax, and the total distribution on the ordinary shares is 8 per cent. for the year, subject to tax. There is to be carried forward £13,091. The expenditure on plant renewals and improvements during the year amounted to £44,911, which has been charged against reserve for plant renewals and improvements account. The unsettled conditions in trade, and the continued high labour costs have again adversely affected the trading for the year. The additional capital expenditure for the year has amounted to £475,459, and represents the completion of the remaining extensions at Carville and further extensions at Dunston power stations, and additions to the company's distribution system generally. The extensions at Carville power station were completed during the year, and the new plant is now in commission. Negotiations with the North Eastern Railway Co. are proceeding in connection with the electrification of a portion of that company's main line. The directors have been approached with the object of obtaining a contribution to the funds of the University Colleges of Newcastle-upon-Tyne, and recommend to the shareholders that an amount of £1,000 be sanctioned, payable over two years.

Meeting: March 22nd.

Oxford Electric Co., Ltd.

Speaking at the annual meeting, Sir Henry Mance said that 1920 was the first normal year they had had since the commencement of the war. The coal strike, and the extension of summer time to October were detrimental, but, notwithstanding this, their output had increased by 26 per cent. The great advance in the rates of wages and the cost of coal and other commodities had necessitated their applying for an increase in the statutory charge; this had been granted, and was now in operation. With regard to legislation, it would be a long while before any material change could be made in the distribution of electric power throughout Oxfordshire or the neighbouring counties. According to the *Times* report, Sir Henry said that the further measure which would be under the consideration of Parliament this session appeared to be an enabling Bill giving lending and borrowing powers to various authorities, but he did not expect much assistance in the future in that direction. What they really wanted was willingness on the part of the Government to guarantee interest on any money advanced with the latter's approval for the purpose of cheapening and extending the production and distribution of electricity. If the Government would take that responsibility, which would cost them nothing, they would be rendering a real service to the industry throughout the country.

London Electric Wire Co. and Smiths, Ltd.

In addressing the annual general meeting held in London last week, Sir George H. Fisher-Smith, J.P., said that the final dividend of 6¼ per cent. (making 7½ per cent. for the year) on the ordinary shares would leave £38,926 to be carried forward, or £10,512 more than in the previous year. He described 1920 as one of the most difficult years for commerce ever known. The present lack of business was due to the almost entire absence of purchasing power. There was plenty of work to be done, but there was not sufficient money to pay for it. The time had arrived when the cost of production would have to be seriously reconsidered, and capital and labour would have to work together to that end in their mutual interest if we were to retain our great manufacturing position in the world. He believed that the present financial stringency was largely due to excessive taxation. It was difficult to forecast the future, but he was under the impression that we were nearing the bottom of the reductions in the values of raw material, and if prices could be stabilised buyers both at home and abroad would have confidence in placing orders, and in consequence a revival in trade would surely take place. The electrical industry would be one of the first to revive, because a successful future would demand more and more the use of electricity. Their company was ready to meet the expansion when it came.

Mr. A. N. Smith stated that the company had managed to make a record output during the past year at its Manchester factories. The completion of the new extensions was in sight.

County of Durham Electrical Power Distribution Co.—Dividend of 12 per cent. for the year on the ordinary shares; carried forward £1,275.

Mirrlees Watson Co., Ltd.—Dividend for 1920, 10 per cent., and a bonus of 7½ per cent., both less tax.

British Insulated & Helsby Cables, Ltd.—Profit for 1920, after making provision for estimated liability for E.P.D. and corporation profits tax to date, is £340,713, plus £103,316 brought forward, making a total of £444,029. From this are deducted: directors' and debenture trustees' fees and remuneration to works committee, £9,665; interest on first debenture stock, £22,500; interest on second debenture stock, £10,000; preference dividend, £30,000. There has been put to depreciation on buildings, plant, machinery, &c., £50,000; to reserve account, £50,000; and to first mortgage debenture stock redemption account, £5,000. The interim dividend on ordinary shares absorbed £37,500, and it is proposed to pay a further dividend of 6¼ per cent. on the ordinary shares at once, and a bonus of 5 per cent. on June 30th next, making with the interim dividend already paid a total of 15 per cent. for the year, absorbing a further £112,500. There is carried forward, after making provision for estimated liability for E.P.D. and corporation profits tax, a balance of £116,864. During the past year, both the Prescot and Helsby factories were again kept busy to their full capacity. On account of failing health, Dr. E. K. Muspratt resigned his seat on the board. Mr. J. A. Smith has recently been elected a director.

Electro-Bleach & By-products, Ltd.—The profit for 1920, after deducting repairs, standing charges, depreciation, income tax, debenture interest, bonus to employés, directors' additional remuneration, and reserve for E.P.D. and corporation profits tax, is £51,643, plus £4,277 brought forward. Preference dividend 12½ per cent. for the year; ordinary dividend 25 per cent. for the year; carried forward £5,921. Sir H. Mackinder, M.P., and Mr. E. G. Cubitt, J.P., resigned their seats on the board during the year. Messrs. H. D. Butchart, E. O. Glover, and A. W. Tangye, O.B.E., have been appointed directors. Mr. F. J. Dundas and Mr. James Swinburne retired in December, 1920, but at the request of the directors have rejoined the board. Meeting: March 23rd, at Manchester.

Scarborough Electric Supply Co., Ltd.—New connections during 1920 equivalent of 16,438 lamps (30 watt), making 161,141. New consumers 449. Units supplied 1,454,377, increase 396,670. After putting £4,000 to depreciation, and paying £755 bank interest, the profit is £2,370, plus £2,339 other revenue, making the net profit £4,709, plus £6,683 brought forward. Dividend to be paid at the maximum rate allowed under the Scarborough Electricity (Temporary Increase of Charges) Order, 1918, namely, 2½ per cent., leaving £9,142 to be carried forward. Mr. G. Alderson-Smith has retired from the chairmanship, and Mr. A. A. C. Swinton takes his place. The former remains as deputy chairman. Mr. G. L. Beeforth has retired. New directors are Messrs. R. Pawley, F. G. Holden, and Capt. W. H. L. Wordsworth.

Brompton & Kensington Electricity Supply Co., Ltd.—The revenue account for 1920 shows a credit balance of £42,903, plus £1,230 brought forward; £1,000 interest on loan to the B. & K. Accessories Co., Ltd., and £274 interest received and accrued, making a total of £45,406. After paying 7 per cent. on the cumulative preference shares, £369 is written off investments, £9,655 is put to depreciation, £10,000 to reserve, 12 per cent. for the year is paid on the ordinary, £1,000 is put to directors' additional remuneration, and £1,776 is carried forward. The number of customers increased from 7,389 to 7,896; lamps connected (35 watt) from 433,152 to 472,936; gross receipts from £74,045 to £102,372; expenditure from £44,683 to £59,469; net receipts from £29,362 to £42,903; average price per unit obtained, from 4.61d. to 5.303d. Meeting: March 17th.

Cambridge Electric Supply Co., Ltd.—Mr. R. F. Scott, presiding at the annual meeting, said that the net profit was £900 more than in 1919, and £2,000 more than 1918. They had hardly recovered their pre-war position. They were paying 46s. for coal, against 18s. 3d. or less a few years ago, and the coal now was not quite so satisfactory. The business was still expanding, and must do so. They would have to provide new machinery, and probably before the end of the year would have to raise £10,000 new capital.

Globe Telegraph & Trust Co., Ltd.—Quarterly interim dividend of 5s. per share on the old and new ordinary shares, free of tax; further 4s. 8d. per share, being interest at the rate of 10 per cent., free of tax, in respect of the instalments paid on the new ordinary shares.

Western Telegraph Co., Ltd.—Second quarterly interim dividend of 5s. per share, free of income tax, to holders of old shares Nos. 1 to 207,990 inclusive, being at the rate of 10 per cent. per annum. The dividend of 4s. per share, free of income tax, on the new shares, in accordance with the terms of the issue is also announced.

Direct Spanish Telegraph Co., Ltd.—Dividends of 10 per cent. per annum, less tax, on the preference shares, and 6 per cent., free of tax (making 10 per cent. for the year) on the ordinary.

Stock Exchange Notice.—Application has been made to the Committee to appoint a special settling day in the following:—

Midland Electric Corporation for Power Distribution.—280,000 ordinary shares of £1 each, fully paid, Nos. 1 to 280,000.

Hastings & District Tramways Co., Ltd.—After paying 7½ per cent. on the preference shares and putting £3,000 to depreciation, £1,000 is to be carried forward.

South Staffordshire Tramways Co.—After paying 4 per cent. on the preference shares, £668 is to be carried forward.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets have got into a much better state of mind. Members admit that they are puzzled to account for the change of front that has occurred in markets. The obvious explanation is that there is more buying than selling. The forced realisations apparently have ceased. Prices had to get down to levels at which they were tempting, but for the last 2½ months Stock Exchange men have been complaining that nobody had any money except for purely gilt-edged stocks. Nor can it be said that the present movement has any substantial backing of purchases behind it. It is almost as much sentimental as real, but the fact remains that the market outlook is more healthy, and this possibly has led to the greater hopefulness which has arisen in regard to trade and industry generally. There is every hope of the Bank Rate coming down before the Budget is opened, and the Spring of the seasons is reflected in that of the markets.

At the meeting of the London Electric Wire Company the other day, Sir G. H. Fisher-Smith expressed his belief that the electrical industry would be one of the first to revive. His impression is that we are near the bottom of the reduction in the values of raw material, and if (a big "if") prices could be stabilised, buyers both at home and abroad would have confidence in placing orders, and in consequence a revival in trade would surely take place. This may be taken as a very fair sample of the optimism which has sprung up in regard to trade. It certainly has its effect upon industrial shares. Edisons have recovered from 8s. 9d. to 10s., and, although the other manufacturing issues are still under a cloud, it is no longer so difficult to sell them as it was even a fortnight ago. The report of the W. T. Henley's Company makes a capital showing. The company repeats its 15 per cent. dividend paid for the last three years, and carries forward the substantial amount of £183,000, which is an increase of £42,000 over that of last year. It may be recalled that the present 15 per cent. dividend is equal to 30 per cent. on the capital as it stood before the latter was doubled in 1918. The report mentions that the holding in Henley's Tire and Rubber Company is now £200,000, an increase of £60,000 as compared with a year ago.

City of London Electric ordinary have gone back to 24s. 6d., but on the other hand, County ordinary are better at 7½, and the preference hold their rise at 8½. We have heard two or three inquiries lately as to whether the County Company is likely to follow the example of the City of London, and split its shares into the more easily negotiable denomination of £1. Charing Cross and Metropolitan ordinary shares are both ex dividend, showing no particular change allowing for the deductions, which, however, have the effect of making the yields on the shares still more attractive than they were before. Westminsters continue a shade under £5. The Newcastle-on-Tyne report is a good one, but the ordinary shares remain at 15s. 6d.

It may be of interest to remark, incidentally, that last week the electricians employed by one of the big London boroughs presented what amounted to an ultimatum to the Borough Council, stating that any re-adjustment of wages must be considered only on a basic line of 150 per cent. increase over the wages paid just before the war broke out. In other words, the pre-war wage was multiplied by 2½ to arrive at a starting point from which fresh adjustment of wages would alone be considered.

The rises in Home Railway stocks are mostly confined to those in the steam division, where material improvements have occurred this month. Some of the stocks are 10 points higher than they were at the beginning of March. With them have advanced the prior-charge issues, and the pre-ordinary stocks of the Metropolitan, the District, and the Central London companies have kept pace. Metropolitan 3½ per cent. "A" debenture stock has recovered to 55½ and the 3½ per cent. "B" debenture to 53. District prior-lien debenture at 58 and the 6 per cent. debenture stock at 54 are both better. The three issues of Metropolitan 3½ per cent. preferences have hardened to 43, while the 5 per cent. preference has risen to 61. There is a fair amount of cover-margin for the debenture stocks of all the electric companies. The London Electric, the District, and the Central London securities have an additional protection in a Common Fund agreement with three of the Underground Railways and the London General Omnibus Company, which secures the prior-charges of all, before the ordinary stocks of any receive their allotted share of the pooled receipts. The ordinary stocks of the electric companies are steady, without any particular feature declaring itself. Metropolitan is ¼ up and Underground Electric £10 shares ½ higher, the latter movement replacing the loss of last week.

The feature amongst cable issues is the manner in which Marconi's have spurted. Towards the end of last week a buying movement developed which has lifted the price 3/16 to 38s. 9d., from which it reacted to 1 7/8. Apparently there is something of a bear account in the market, for the volume of buying has been comparatively small. Marconi Marines have risen in sympathy to 25s. 9d. Radio Corporation Common are better at 8s. 3d., the preferred remaining about 10s. 9d. The cable group itself is very quiet. Anglo-American deferred eased off to 16, and United River Plate Telephones at 6½ are ¼ lower. Stock Exchange members regard with curious interest a dozen or more of huge drums outside the Shorter's Court entrance to the markets. The drums bear Callender's lettering, and are said to be awaiting practical use in the direction of further telephonic facilities for the Stock Exchange.

Babcock & Wilcox have risen to 2½, an improvement of 5s., the whole of the iron and steel market being decidedly better on the impression mentioned above, that trade has reached its lowest curve, and that from now onwards the course of industry should expand. Armaments are better for the same reason, there being quite material rises in Vickers and certain others of this class. On the other hand, British Aluminium ordinary are weak at 15s. 9d., British Insulated have dropped to 30s., and English Electrics to 11s. 9d. Metropolitan-Vickers preference, despite the rise in Vickers shares, gave way to 1½. General Electrics are harder at 1½, and Siemens improved to 20s. 6d. Telegraph Constructions at 20½ are ex the recently paid dividend. Prices in the rubber share market are better, more in sympathy with other markets than for any intrinsic reason. Indeed, the price of rubber has dropped below 1s. per lb.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1919.	Dividend 1920.	Price March 15, 1921.	Rise or fall.	Yield p.c.
Brompton Ordinary	12	12	6½	—	£9 16 0
Charing Cross Ordinary	7	8	8¼xd	—	10 13 4
do. do. 4½ Pref.	4½	4½	5½	—	8 3 8
Chelsea	4	6	8¾	—	9 10 6
City of London	18	14	24/6	—6d.	11 8 6
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	6	8	7½	+ ¼	10 6 6
do. do. 6 per cent. Pref.	6	6	8½	—	7 5 5
Kensington Ordinary	7	9	4	—	11 5 0
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref.	6	6	2¾xd	—	10 18 2
Metropolitan	6	7	2¼xd	—	12 8 6
do. 4½ per cent. Pref.	4½	4½	2½	—	8 15 8
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	—	2⅜	—	9 2 10
South Metropolitan Pref.	7	7	11/9	—	8 17 10
Westminster Ordinary	10	10	4½	—	10 5 2

Telegraphs and Telephones.

	1918	1919			
Anglo-Am. Tel. Pref.	6	6	83½	—	7 9 3
do. Def.	33/6	1½	16	— ¼	9 7 6
Chile Telephone	8	6	5½	— ¼	*5 6 8
Cuba Sub. Ord.	7	7	8½	—	*10 15 4
Eastern Extension	10	10	15½	—	*6 6 0
Eastern Tel. Ord.	8	10	160½	—	*5 4 7
Globe Tel. and T. Ord.	8	10	15¾xd	—	*6 8 0
do. do. Pref.	6	6	½xd	+ ¼	6 13 4
Great Northern Tel.	22	22	30½	—	10 14 8
Indo-European	18	10	30	—	5 6 8
Marconi	25	25	1⅞	+ ⅛	—
Oriental Telephone Ord.	10	12	6⅞	—	*5 9 7
United R. Plate Tel.	8	8	6¼	— ¼	*6 13 8
West India and Panama	1/3	Nil	⅞	—	Nil
Western Telegraph	8	10	13	—	*6 5 0

Home Rails.

	1919	1920			
Central London Ord. Assented	4	4	45½	—	9 4 3
Metropolitan	1½	1½	21	+ ½	7 3 10
do. District	Nil	Nil	13½	—	Nil
Underground Electric Ordinary	Nil	Nil	1½	+ ¼	Nil
do. do. "A"	Nil	Nil	8/-	—	Nil
do. do. Income	4	2	65½	—	1 19 8

Foreign Trams, &c.

	1918	1919			
Anglo-Arg. Trams, First Pref.	Nil	5½	18	—	10 9 6
do. do. 2nd Pref.	Nil	Nil	2½	—	Nil
do. do. 5 % Deb.	5	5	89½	-1	8 8 0
Brazil Tractions	Nil	Nil	37	+ ½	Nil
British Columbia Elec. Ry. Ptcs.	5	5	56	—	8 18 6
do. do. Preferred	2½	5	64½	+1	*8 14 0
do. do. Deferred	Nil	3	61½	+1	*11 17 6
do. do. Deb.	4½	4½	89½	-1	7 11 3
Mexico Trams 5 per cent. Bonds	Nil	Nil	39	—	Nil
do. 6 per cent. Bonds	Nil	Nil	23½	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	61	-1½	Nil

Manufacturing Companies.

Babcock & Wilcox	15	15	32	+ 2½	*6 6 4
British Aluminium Ord.	10	10	15/9	— ⅛	14 14 0
British Insulated Ord.	12½	15	1½	— ½	10 0 0
Callenders	25	15	18	—	10 18 2
" 6½ Pref.	—	6½	17/6	—	7 8 7
Castner-Kellner	20	17	23	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	10/-	— ⅛	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	15/9	—	12 14 0
English Electric	—	8	11/-	-1/6	14 11 0
Do. Pref.	—	6	12/6	—	8 17 10
Gen. Elec. Pref.	6½	6½	12/6	—	7 2 5
do. Ord.	10	10	1½	+ ⅛	*8 17 9
Henley	25	15	1½	—	10 18 2
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India-Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	18	—	9 17 0
Siemens Ord.	10	10	20/6	—	*9 15 9
Telegraph Con.	20	20	20½xd	—	*5 18 2

* Dividends paid free of Income Tax.

THE INFLUENCE OF TRANSFORMER CONNECTIONS ON THIRD HARMONIC VOLTAGES & CURRENTS.

By S. AUSTEN STIGANT, A.M.I.E.E., M.Am.I.E.E.

(*Continued from page 302.*)

Table II is a summary of the conditions obtaining with different connections of double wound transformers for three-phase service. It has already been seen under the heading of "origin"-that third harmonics must occur in either the magnetising current or the voltage of each phase, and it should now be borne in mind that as a power transformer is connected across the supply voltage and not in series with the line the magnetising current will wherever possible take the shape required by the particular connections and condition of service. In consequence of this, where it is not possible for the third harmonic component of the magnetising current to circulate in the primary it will be transferred to the secondary by magnetic induction if the secondary connection is such as to allow circulation of the third harmonic to take place.

When both primary and secondary connections are such as to allow the circulation of the third harmonic component of the magnetising current the component will split up and circulate round each winding in inverse proportion to the impedance of the two windings.

This is the case whether the closed circuit is formed due to the inherent properties of the connection chosen, such as with the delta connection, or due to the conditions of service, such as the star connection with a fourth wire either to the generator neutral on the primary side or to the load on the secondary side.

With reference to Table II the following remarks will make the whole question clear, and indicate the broad principles determining the existence of third harmonics in no-load currents, flux, and induced voltages.

1. *Star/Star, both Neutrals Isolated.*—As there are no fourth wires to provide a drain for the third harmonic component of the magnetising current, the flux and consequently the voltage from line to ground must contain third harmonics which appear on both primary and secondary sides. The line voltages and the line currents are not affected; the magnetising current is, of course, sine shaped.

2. *Star/Star, Primary and Generator Neutrals Connected Together, Secondary Neutral Isolated.*—The connection between the transformer primary and generator neutrals provides a drain or return circuit for the third harmonic components of the magnetising currents, so that these currents in the transformers will contain third harmonics. There will be no circulation of magnetising current on the secondary side on account of the insulated neutral point. The sine components of the no-load currents do not flow through the connection between neutrals as they are already balanced in the three phases. As the third harmonic currents must flow through the lines and generator windings then, due to this additional impedance, the currents will be less than if they simply had to circulate round, say, a closed delta secondary only. Consequently the m.m.f. per phase of the transformers is less than that required to eliminate the third harmonic voltages to neutral; that is part of the e.m.f.'s neutralising the third harmonic voltages act across the transformers and part across the lines and generator windings. Therefore a portion of the original third harmonic voltage still appears between lines and ground on both primary and secondary sides, while in addition a third harmonic component of the no-load current circulates in the primary windings and in the lines between transformer and generator.

Fig. 9 shows the proportion of third harmonic current and voltage components occurring with this connection with different ratios of the impedance of lines plus generator windings to transformer windings, and it is to be noted that as this ratio approaches infinity (*i.e.*, disconnected neutrals) the current approaches zero and the voltage its maximum value.

The flux wave, therefore, contains a small third harmonic component corresponding to the resultant third harmonic voltage component, which latter appears in the voltage from line to ground on both primary and secondary sides. The voltages between lines on both sides of the transformer are sine shaped. The no-load current flowing in the primary winding contains a third harmonic component smaller than that

TABLE II.—STATEMENT ON THE INFLUENCE OF THREE-PHASE TRANSFORMER CONNECTIONS ON THIRD HARMONICS.

Third harmonics in double-wound, single-phase, core and shell-type transformers and in three-phase, shell-type transformers for three-phase service. Sine wave of applied voltage.

No.	Connections.	Primary				Flux.	Secondary			
		Currents		Voltages.			Currents.		Voltages	
		No Load	Line	Line	Phase		No Load	Line	Line	Phase
1.	Star in./Star in.	Sine	Sine	Sine	Contains 3rd. H. P.	Contains 3rd. H. F.T.	—	Sine	Sine	Contains 3rd. H. P.
2.	Star N.to G/Star in.	*Contains 3rd. H. P.	*Contains 3rd. H. P.	Sine	*Contains 3rd. H. P.	*Contains 3rd. H. F.T.	—	Sine	Sine	*Contains 3rd. H. P.
3.	Star in./Star 4 Wire	Sine	Sine	Sine	*Contains 3rd. H. P.	*Contains 3rd. H. F.T.	*Contains 3rd. H. P.	*Contains 3rd. H. P.	Sine	*Contains 3rd. H. P.
4.	Star in. Tertiary Delta/Star	Sine in Star 3rd. H. in Delta P.	Sine	Sine	Sine	Sine	—	Sine	Sine	Sine
5.	Star in./Delta	Sine	Sine	Sine	Sine	Sine	Contains 3rd. H. P.	Sine	Sine	Sine
6.	Star N.to G/Delta	*Contains 3rd. H. P.	*Contains 3rd. H. P.	Sine	Sine	Sine	*Contains 3rd. H. P.	Sine	Sine	Sine
7.	Star in./Interconnected Star in.	Sine	Sine	Sine	Contains 3rd. H. P.	Contains 3rd. H. F.T.	—	Sine	Sine	Sine
8.	Star in./Interconnected Star 4-Wire	Sine	Sine	Sine	Contains 3rd. H. P.	Contains 3rd. H. F.T.	—	Sine	Sine	Sine
9.	Delta/Star in.	Contains 3rd. H. P.	Sine	Sine	Sine	Sine	—	Sine	Sine	Sine
10.	Delta/Star 4 Wire	Contains 3rd. H. P.	Sine	Sine	Sine	Sine	Contains 3rd. H. P.	Contains 3rd. H. P.	Sine	Sine
11.	Delta/Delta	Contains 3rd. H. P.	Sine	Sine	Sine	Sine	Contains 3rd. H. P.	Sine	Sine	Sine

* In all these cases the third-harmonic component is less than it otherwise would be if—(a) The circulating third-harmonic current flowed through a closed delta winding only, or (b) The neutral point was isolated.
I N means "isolated neutral." N to G means "transformer primary neutral connected to generator neutral." P means "peaked wave." F T means "flat top wave."

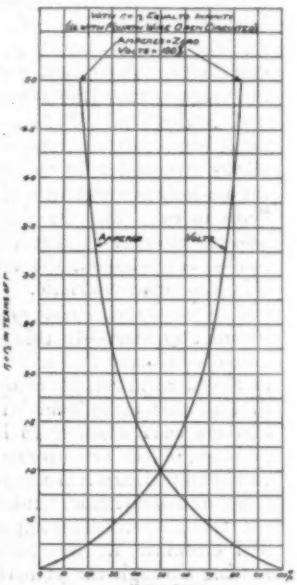

FIG. 9.—CURVES SHOWING PERCENTAGE THIRD HARMONIC CURRENT AND VOLTAGE IN STAR/STAR CONNECTED BANKS OF SINGLE-PHASE TRANSFORMERS WITH FOURTH WIRE ON PRIMARY SIDE.

which normally occurs in accordance with the ratio of the external to internal impedance. The line current on the secondary side of the transformer remains sine shaped.

3. *Star/Star, Primary Neutral Isolated, Fourth Wire on the Secondary Side.*—In this case the fourth wire on the secondary side operates exactly in the same way for the third harmonic components of the no-load current as does the fourth wire on the primary side in case (2). The factors governing the magnitude of the third harmonic current and voltage components are the same as given under the previous heading, so that with this connection a small third harmonic occurs in the flux wave corresponding to the resultant third harmonic voltage component from line to ground which appears on both the primary and secondary sides. A third harmonic component of the no-load current circulates in the transformer secondary windings and through the line wires and neutral connection. The no-load current in the primary side is sine shaped. All other functions are sine shaped as stated in Table I.

4. *Star, Tertiary Delta/Star, Primary and Secondary Neutrals both Isolated.*—In this case the auxiliary tertiary delta provides a closed path for circulation of the third harmonic component of the no-load current so that the current in the star primary is sine shaped, and the third harmonic current appears in the tertiary delta only. The flux is a sine wave, and so also are all the voltages and line currents.

5. *Star/Delta, Primary Neutral Isolated.* — The delta connected secondary provides a closed path, and allows circulation of the third harmonic component of the no-load current in a similar manner to the tertiary delta in case (4). On the primary side, therefore, the no-load current is sine shaped, and as the flux wave is also sine shaped, the remaining functions will have this same characteristic.

6. *Star/Delta, Primary and Generator Neutrals Connected Together.*—In this case a closed path is provided on both primary and secondary sides for the circulation of the third harmonic component of the no-load current so that this component will split up, part circulating through each winding in inverse proportion to the impedance of the two circuits. On account of the additional impedance introduced on the primary side by the lines and generator windings, the greater portion of the third harmonic component of the no-load current will circulate in the delta secondary, the remainder flowing through the primary windings, lines, and generator windings. The flux wave will be sine shaped so that the voltages on both sides will be free from third harmonics.

7. *Star/Interconnected Star, Primary and Secondary Neutrals both Isolated.*—As there is no closed circuit on either primary or secondary sides which will allow the third harmonic component of the no-load current to circulate, a third harmonic component will be contained in the flux wave which on the primary star connected side will produce a third harmonic in the voltage wave from line to ground, though not appearing in the voltage between lines. On the secondary side the voltage across the whole of the winding on each transformer if connected in series would also contain a third harmonic component, but by interconnecting the windings of the *different* transformers the third harmonic voltage components of the halves of the windings which are now in series, and electrically constitute each phase, oppose one another, and so cancel out. On the secondary side, therefore, neither third harmonic components of voltage from line to neutral nor of current exist. The secondary line voltage will also be sine shaped. It is to be noted, however, that should a connection be taken from the point where the half of the windings of one transformer is joined in series to the half of the windings of another transformer a third harmonic voltage component will be contained in the pressure from this point either to neutral or to the line. The no-load current flowing in the primary side and also the primary and secondary load currents will be sine shaped.

8. *Star/Interconnected Star, Primary Neutral Isolated, Fourth wire on Secondary Side.*—It was shown under the previous heading that no third harmonic component of the voltage from line to neutral existed on the secondary side, and therefore the addition of a fourth wire on this side will not result in a circulation of third harmonic current component as there is no voltage component to maintain such a flow. The conditions, therefore, will be exactly the same as with the previous connection.

9. *Delta/Star, Secondary Neutral Isolated.*—The conditions with this connection are identical with those obtaining for the star/delta under sub-heading (5), with the exception that the whole of the no-load current is supplied on the primary side as the third harmonic component circulates in the delta winding. All other functions are sine shaped.

10. *Delta/Star, Fourth Wire on Secondary Side.*—From the point of view of third harmonics this case is the reverse of that outlined under sub-heading (6). A closed path is similarly provided on both primary and secondary sides for the circulation of the third harmonic component of the no-load current, so that this component will be split up, part circulating through each winding in inverse proportion to the impedance of the two circuits. In this case additional impedance

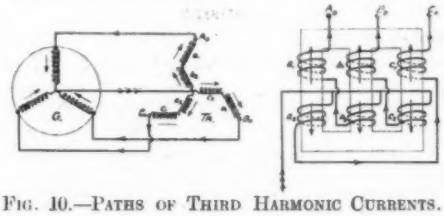

Fig. 10.—Paths of Third Harmonic Currents.

is introduced on the secondary side by the fourth wire and the load, so that the greater portion of the third harmonic component of the no-load current will circulate in the delta primary, the remainder flowing through the secondary windings, lines, and load. The flux wave will be sine shaped, so that the voltages on both sides will be free from third harmonics.

11. *Delta/Delta.*—In this case the closed delta windings on each side of the transformer offer a path of minimum impedance for the flow of the third harmonic component of the no-load current which will be split up, part circulating through each winding in inverse proportion to the impedance of the two circuits. The flux wave will be sine shaped so that the voltages on both sides will be free from third harmonics.

A note of warning should be struck against the advisability of joining together the generator and transformer primary neutrals (either *via* earth or direct by a fourth wire) *if the transformer primary is connected in the interconnected star manner.* If the neutrals are joined a third harmonic current may flow in the fourth wire resultant from third harmonic voltages in the source of supply, and due to the splitting and interconnection of the transformer primary windings, the third harmonic exciting ampere turns, and consequently the induced back e.m.f.'s in the halves of the windings on each limb of the transformer, neutralise each other, thereby providing a low impedance path (virtually a short circuit, so far as transformer reactance is concerned) for the flow of third harmonic currents. Such currents would only be limited in magnitude by the impedance of the generator winding and by the resistance of the connecting cables and transformer windings, and they would reach such large values in practice as seriously to overload the transformer and generator windings. Fig. 10 shows the paths of the third harmonic currents, and in both sketches the opposition of third harmonic exciting ampere turns in the halves of the windings on each limb of the transformer will be seen.

The final conclusions arrived at under headings (1) to (10) of the tabular statement apply strictly to single-phase transformers of both shell and core types, and

to three-phase shell type transformers, as with each of these types of construction the magnetic circuit of each phase is complete in itself, and no interchange of m.m.f. and flux occurs between the phases. With three-phase core type transformers of the usual construction in which there are three limbs only, the case is somewhat different. With this type of transformer any third harmonic fluxes tending to flow would have the same instantaneous direction up or down each limb, and in order to preserve the magnetic balance of the core the third harmonic flux in each limb must find its return path outside the core through the oil (or air) and tank. Such a path is of very high reluctance, and consequently the third harmonics in the flux and induced voltage waves are very small.

[The following are the equations to curves reproduced in our last issue:—

Figs. 3 and 7A.—$i_m = 1{\cdot}16 \sin \theta - 0{\cdot}635 \sin 3\theta + 0{\cdot}365 \sin 5\theta + \ldots$

Fig. 5.—$B = 3{\cdot}36 \sin \theta + 0{\cdot}77 \sin 3\theta + 0{\cdot}19 \sin 5\theta + \ldots$

Figs. 5 and 7B.—$E = 4{\cdot}8 \cos \theta + 3{\cdot}3 \cos 3\theta + 1{\cdot}36 \cos 5\theta + \ldots$

An unfortunate error occurred in engraving the block for fig. 3, p. 301. Apparently in making the block a flaw appeared, and the engravers, in making it good, inaccurately touched in the rising part of the curve of magnetising current i_m, so that it crosses the zero axis 30 deg. ahead of the induction B. As hysteresis effects are excluded in fig. 3, the magnetising current and induction waves are in phase, and should intersect on the axis, as correctly shown in the descending portion.]

(To be concluded.)

A THIRD WEST RIDING (AIRE AND CALDER) ELECTRICITY SUPPLY SCHEME.

Consequent upon the provisional delimitation of the above-named district, two schemes have been submitted (one by the Leeds Corporation,* and the other by a Conference of West Riding Local Authorities†) for the improvement of the existing organisation for the supply of electricity in, and the formation of a Joint Electricity Authority for, the area. Certain representations have, however, also been made by the Yorkshire Electric Power Co. in connection with the district. The Power Co.'s proposals, which are signed by Mr. W. B. Woodhouse, engineer and manager to the company, point out, *inter alia*, that the proposed district is almost wholly within the area of supply granted to the company by the Yorkshire Electric Power Act, 1901, but does not include a large and important part of the company's area. The company objects to the division of its area of supply on the grounds that it will restrict the operation of the company as one undertaking, will increase working costs, and will be disadvantageous to the users of electricity. Certain districts forming a small portion of the proposed district are outside the present area of supply of the Power Co., but it would be prepared to undertake the supply of electricity if required to do so in such districts. The company's area of supply extends into three proposed electricity districts as shown in the accompanying map, for each of which the Commissioners require schemes to be submitted.

Fig. 1.—Yorkshire Electric Power Co.'s Area of Supply and Proposed Electricity Districts.

The company submits that no necessity can be shown for the establishment of a Joint Electricity Authority in the proposed district; the company was created by Act of Parliament substantially for the purposes for which a Joint Electricity Authority would be established, and Section 12 of the Electricity (Supply) Act, 1919, recognises the special position of the Power Co. by restricting the supply of electricity by a Joint Electricity Authority in the Power Co.'s area.

It is submitted that rapid development of supply can best be maintained by the utilisation of the existing organisations. The purchase by a Joint Electricity Authority of existing undertakings would result almost certainly in an immediate increase in the cost of electricity to the consumer, and would involve either financial assistance from the State or an obligation on the ratepayers to defray losses out of the rates, which burden would largely fall on districts in which a supply of electricity from the company is now available without any risk to the ratepayers. The company has in the past found large sums of money, and is prepared to find such further capital as may be necessary; in view of the existence of the Power Co. the creation of a Joint Electricity Authority would involve uneconomical duplication and unnecessary expense.

The delay already occasioned by the restrictions imposed prior and subsequent to the passing of the Electricity (Supply) Act, 1919, has created a serious position of affairs such that new and extended demands for power have been delayed. The company proposed, in 1918, to construct a capital power station at Ferrybridge, and in conjunction with the Mexborough District Council, another station at Mexborough, but the company has not been permitted to proceed with either of these much-needed works pending the proposed inquiry (which is to be held at Leeds on April 15th next). Any further delay such as would be inseparable from the constitution of a new body would result in a serious shortage of supply, which would cause uneconomical stations to be extended; manufacturers and others who require power immediately will be forced to install their own power plant, and the economy of capital and of working expenses which would have been obtained will be lost.

In the company's area of supply there are 62 electricity undertakings, a large measure of unification has already been brought about, and the existence of an extensive system of mains makes further unification easy of attainment. Of the undertakings 24 are owned by Electrical Distribution of Yorkshire, Ltd., a company working in conjunction with the Power Co., and of the 62 undertakings the company is supplying or has entered into an agreement with 40. Seven of the remainder have not commenced to supply electricity, leaving 15 of the working undertakings not yet associated with the company, but the company is willing in all these cases to enter into agreements for supply.

The agreements which the company has made include agreements with the Corporations of Bradford, Rotherham, and Sheffield, for interchange of supply, mutual assistance and the avoidance of overlapping, and it is submitted that a continuation of development on these lines, subject to the control of the Commissioners, will produce the best results. In recent years there has been a growing spirit of co-operation, and the powers granted to the Commissioners give sufficient assurance that future developments will not be obstructed.

The rapid growth of the company's undertaking is indicated by its annual revenue as follows: 1911, £36,829; 1914, £71,304; 1917, £146,272; and 1920, £381,693.

The company's area of supply includes the Yorkshire coal field, which extends continuously from north to south across the boundary of the proposed district, and the company's extensive system of mains is available, not only for supply to collieries and all classes of users, but for taking power from those collieries which may have a surplus derived from waste heat. The company has already entered into several arrangements of this nature, and in particular the company's Barugh power station utilises as fuel a large amount of surplus coke-oven gas, and an arrange-

* Elec Rev., p. 95, Jan. 21st, 1920.
† Elec. Rev., p. 324, March 11th, 1921.

ment has been entered into for a further large supply of gas fuel to this station which will result in a still larger saving of coal.

In view of possible developments in the use of low-grade fuel the co-operation of the Power Co. with the colliery owners is likely to have an important effect in reducing the cost of producing electricity in the future. It is submitted that in such new developments a company undertaking will obtain the best results.

The maintenance of the company's rapid development and the provision of the further large capital sums required will depend largely on the continuance of confidence on the part of investors that, subject to the proper performance of its statutory obligations, the company's security will not be disturbed by the granting of overlapping powers to any other body. If the Commissioners are of opinion that, although the present time is inopportune for the creation of a Joint Electricity Authority, a provision for the future purchase of the company's undertaking by a Joint Electricity Authority would be desirable, the company will be prepared to consider such a condition. It is urgently necessary to proceed with the construction of a power station at Ferrybridge without further delay.

The company requests that the proposal submitted to the Corporations concerned in December, 1919, as set out below, be dealt with by the Commissioners under Section 19 of the Electricity (Supply) Act, 1919: (*a*) The Corporations of Bradford, Halifax, Huddersfield, and Leeds, and the Yorkshire Electric Power Co., to enter into an agreement for co-operative working of their generating stations, interchange of supply, and mutual assistance. (*b*) Each of the parties to retain the ownership and management of their respective generating stations, and to generate energy for their own requirements and for the purposes of the joint arrangement as required from time to time. (*c*) Provision of further generating plant from time to time to be made by agreement between the parties, or failing agreement, the Commissioners to decide which party shall provide the plant required. The party making provision of generating plant may require the other parties to enter into agreements to take supply to an amount and for a period and on terms which will justify the expenditure incurred. (*d*) The parties to supply energy to one another on terms which will encourage generation in the most economical manner.

The company requests that the restriction on the supply of electricity for lighting in districts where there are no authorised distributors, imposed by Section 48 of the Yorkshire Electric Power Act, 1901, be removed and, if considered necessary by the Commissioners, the company is prepared to assist in the formation of a joint committee representing authorised undertakers, local authorities, consumers of electricity, and other interests with the objects of: (*a*) Making recommendations as to the co-ordination of the activities of various authorised undertakers; (*b*) taking into consideration the economical and efficient supply of electricity to meet the requirements of the area and the existing provision made for that purpose; and (*c*) acting in an advisory capacity to the Electricity Commissioners and such authorised undertakers.

If so desired, powers to be granted to any local authority in the company's area to give financial assistance in any form to the company, subject in each case to the approval of the Commissioners. It may be that some or all of these proposals are beyond the powers of the Electricity Commissioners to grant, in which case the Company requests the Commissioners to support an application by the company to Parliament for the necessary powers.

THE TEMPERATURE LIMITS OF LARGE ALTERNATORS.

Discussion at Leeds.

Mr. G. A. Juhlin read his paper on the above subject, which was abstracted in our issues of February 4th and 11th, to the members of the North Midland Centre of the Institution of Electrical Engineers, at Leeds on February 8th. The chair was occupied by Mr. W. M. Selvey, Sheffield, who regretted that the chairman of the Centre (Mr. J. C. Jewell) was prevented from attending, and remarked that Mr. Juhlin was the principal electrical designer for the Metropolitan-Vickers Electrical Co., and spoke with authority.

In opening the discussion, Mr. Selvey said that if they had actually been getting at the hottest spots temperatures approaching those which Mr. Juhlin proposed to standardise, then Mr. Juhlin was absolutely justified in bringing forward a plea for facing the music. He, the speaker, remembered the first really large power station in this country and what their experiences were. In those days they were never able to catch up to their load, and he thought that, with very few exceptions, that was the state to-day and would be so for the next five years or longer. Although they hoped for wonderful things to be done under the new Electricity Act what little experience they had had of it so far did not suggest speed. The earlier experiences of electrical power were based on a load in which diversity, as they knew it to-day, had not proved its full benefit in levelling up the load; one of the items in the early specifications for turbines was a system of governing which would stand up to very wide fluctuations without appreciable change of speed, particularly applied to keeping a constant voltage on load, which was a very material thing in those early days. That resulted in turbines being fitted with very sensitive forms of governors. The only way to meet the specification was that the over-load, or the load which could be given by the turbine, should be very large compared with its normal rating, and the consequence was that their early turbines, particularly those which Messrs. Parsons were responsible for, could always give 50 or perhaps 100 per cent. overload, according to the conditions at the steam end; the generators that were driven by those machines were wound as they then thought in very generous and ample proportions. Judging by their thermometer tests their rotors and stators were remarkably cool; therefore, a machine which was intended to work at from 3,000 to 3,500 kW, because of those temperatures and because of the tremendous over-load capacity at the steam end, almost immediately got rated up, not by desire, but because the load was always growing so fast that if there was any excuse to use it for higher rating it was so used. The consequence was that those machines had no sooner been put into service than their every-day load grew from 3,500 to 5,000 kW, which did not mean that they were always definitely and entirely run at 5,000 kW, but that there were many times when there was no other alternative. Then a great change came over the scene, and it was only just beginning to come into operation to-day; that was, running machines at higher than what had been the standard speeds, and on the whole with extremely satisfactory results. The question of heat dissipation was something which was operating in a reverse direction on their economy of material; it was economical to adopt a higher speed if the heat losses of the machine were not different, and there were many reasons why they should use bigger machines running at 3,000 r.p.m. if they could have confidence in their insulation. As regarded the larger machines, Mr. Juhlin was showing them the way to an entirely inorganic mineral form of insulation, he was still proposing to use some organic binding material, but at any rate it was an improvement. If they introduced any change in one direction nature always introduced a counter-change which affected the value of what they were trying to do. A good insulator for electricity was, generally speaking, a good insulator for heat; therefore, by using a mineral or silicate form of insulation they adopted a type which tended to keep up the temperature of the metal which it enclosed, but if the insulation was not organic material and could stand high temperatures as mica did, then their old idea about temperature had no foundation. That was a very difficult mental attitude to grasp. Obviously the heat insulating property of the insulation was entirely changed, a mere temperature rise on the outer surface was no longer a criterion, and they had to reconstruct their point of view. Therefore, they must now endeavour to get at the hottest spot and make that the standard, because that was the only thing which really mattered; if everything was pretty safe there, it must be safe elsewhere, and it only remained for them to attack the problem by a new method, that was, to embed some detector right at or near the hot spot. But Mr. Selvey had still some little doubt whether it was possible to do that without interfering in some way with the general solidity of the work in the generator as a whole. One other point which was very material was the difference between 11,000 and 6,000-volt machines. That was going to be quite a big question. Mr. Juhlin said that they must be prepared to run at still higher temperatures at 11,000 volts, because with pure mica insulation they had a bigger temperature gradient. If they had more insulation they would have less room for copper; on the whole they tended to run at a higher density in that copper with higher losses. If that was so there might be a material difference of the order of from 5 to 10 per cent. in the output per lb. of fuel of 6,000 and 11,000-volt machines, and there was an enormous temptation to use 11,000 volts so long as they could.

Mr. Creedy was much interested in Mr. Juhlin's application of the Miles Walker method of calculating temperature rises. He had tried from time to time to make use of the method as described in Prof. Miles Walker's book, but no doubt owing to the causes he had mentioned, and to variations in the tightness of packing of insulation and matters of that character, he had never been able to get satisfactory results. The method seemed to him to be one by which hot spot points could be calculated, not only in turbo-alternators, but in machines of all kinds. The stresses on the rotor of a turbo-generator in the case of short circuit, he took it, were just the same as those on the stator. Were there not methods of limiting those stresses by the use of choker coils and apparatus of that kind to cut down the short-circuit current?

Mr. Spurr considered that the specifying of low temperatures could be assumed to be a method of playing for safety. Authorities would specify for higher temperatures if they felt they could rely on them. Mr. Juhlin's list of failures gave three mechanical and two electrical, but the best of his designs could be wrecked by careless assembling. Mr. Spurr had in mind large stators which were assembled on site, or handled on the railway. Although armature winders

were very careful, yet they were often expected to work and make a good job under very adverse conditions. He believed that some big machines had been wound recently under conditions which made it impossible to expect anybody to work well, and if he was right in his surmise, one of those machines had failed because it was assembled under conditions under which it had no business to be, that was, exposed to weather and uncomfortable circumstances all round. In overcrowded shops things were thrown about anyhow, men were not careful enough, and it did not take very much bad handling of a coil to make it defective. He thought more help could be given to contractors working in a station towards making sound jobs. Another thing that might cause a failure was the air filter. In the United States the blast-furnace people had taken to refrigerating the air after it had passed through the filter in order to dry it; cold air was usually dry air, and he thought that before very long station engineers would have to rely on having a refrigerator plant under their charge. They would then be able to maintain the same temperature all the year round on their alternators, and they would not have machines running at a higher load in the winter and a lower load in the summer.

Mr. J. D. Bailie observed that nearly 25 years ago at a colliery not far from Leeds they had used asbestos insulation on d.c. generators of 150 kW rating at 500 volts. Those machines were still in use. Were the high temperatures referred to by Mr. Juhlin in his tests maintained continuously over the long periods of time named? If so, he thought it would have been of interest if similar experiments had been carried out, but with the current applied for twelve hours and cut off for twelve hours alternately over the whole period of the test—the object being to ascertain the effect of the alternate expansion and contraction of the conductors which would result. The object of anchoring the end windings by wide metal rings was to provide a rigid support. Would not the tendency of those rings, however, with the windings subjected to the high temperatures contemplated, be to prevent their longitudinal expansion, and so to stress the windings against the rings? A point in favour of the higher temperatures proposed, which did not appear to have been touched on so far, was that their effect would enable the diameter of the rotor to be reduced. That, in turn, would be favourable to the use of higher speeds of rotation by reducing the peripheral speed of the rotor. He believed there had been a tendency of late to run rotors at higher peripheral speeds than desirable, up to something like 450 ft. per second. Wet-air filters were not supposed to pass moisture—but did. His firm made a practice of testing the air for moisture by a method which seemed to be fairly satisfactory. His personal feeling was very much in favour of closed-circuit air coolers which were, he believed, being adopted largely. There were many machines running in the country at 11,000 volts, for example, in the stations of the Sheffield Corporation and the Yorkshire Electrical Power Co., and the difficulties had been very slight indeed. Some 15 years ago they installed two 1,500-kW turbo-alternators at 11,000 volts which were still running satisfactorily. Where the requirements were in favour of 11,000 volts, such, for example, as when the supply was for what might be termed local use, rather than for long-distance transmission when a step-up transformer would be used, there seemed to be no very sound objection to it as the generating voltage. He was entirely in agreement with Mr. Juhlin in his advocacy of the ultimate temperature rather than the rise in temperature being specified.

In replying to the discussion, Mr. G. H. Juhlin pleaded that they should not shut their eyes to the conditions under which they had been operating their machines for a number of years. The chairman had referred to the good old days when they had had machines as big as houses, and which had stood overloads. Well, there were certain reasons, and they were now altogether out of the question. The machines were not designed to stand those enormous overloads. In those days they were designing machines for close voltage regulation; that simply meant that their stators were not loaded up anything like they were to-day, and the rotors operated under totally different conditions in so far that an increase in load did not mean the enormous increase in magnetising current that it meant to-day when they overloaded a machine. When machines were being designed for 5 per cent., regulation 2.5-in. air gaps were nothing out of the common. To-day they were running machines three times the size with less than half the gap, so they got a totally different relationship between armature strength and field strength, with the consequence that the capacity was there—the machines were not designed for it, but it just happened because of the condition. They were running at much higher speeds; therefore, the windage losses were much higher, but although their total heat losses were no smaller they were distributed slightly differently. Unfortunately it was not commercially possible to produce insulation consisting of nothing but mica; they had to use a small amount of paper, but they were reducing that to the absolute minimum. They had found that by improved methods of manufacturing the mica insulation, and applying it on the coils, they could get anything from 33 to 50 per cent. more wrap in the same space, which meant that they were squeezing out binding material as much as possible, and were also eliminating any small air spaces that might be in existence. Consequently, if the insulation swelled due to slight clearance in the slot it was still as tight when it was swollen as when it was put in, so that they were approaching, he thought, very much nearer the ideal condition in insulation. He did not propose a higher limit for 11,000-volt machines; what he did want to convey was that, in measuring surface temperatures, they would have with the same surface temperature in two similar machines a much higher temperature in the 11,000 than in the 6,000-volt machine. That was the crux of the whole position. If they designed their machines with embedded temperature detectors then they put the 6,000 and 11,000-volt machines on the same basis. They were operating both of them on internal temperatures, and they knew they were not reaching higher temperatures in the one than in the other, a definite step forward. Experience had shown that rotors never suffered from short circuits, but stators on the other hand, in some cases did. Mr. Creedy's suggestion of introducing choker coils had been applied quite extensively. Reliability was the first and foremost question and always should be. If he (Mr. Juhlin), as a representative of a manufacturer, could go to anyone in the country and say: "Our machines have not broken down for five years," he thought people would flock to buy them and they would then be able to command higher prices than anyone. That was what they were striving for. They were not striving to build cheap machinery, but machinery which would do its service and do it well. Assembling machinery on site was a point which was very often lost sight of. It certainly would help manufacturers enormously if satisfactory facilities were given on sites when machines were being assembled. Winders were only human, and when they considered the enormous responsibilities that devolved upon them it was up to everyone to give proper facilities to them. His (Mr. Juhlin's) company had given up very largely the use of the wet filter; it decreased the margin of safety. At the present time they had some 20 or 30 machines going through the works with closed-circuit air coolers, which eliminated any filter altogether, and did not introduce any dust or dirt into the machine. With regard to refrigeration, he had no doubt but that they would arrive at a time when the air would be cooled down below the atmospheric conditions, but how far off that time was he would not venture to say.

THE LONDON AND HOME COUNTIES ELECTRICITY SUPPLY SCHEME.

The London County Council's scheme for the reorganisation of electricity supply in and the establishment of a Joint Electricity Authority for the above-named district has already been preliminarily outlined.* The scheme itself, so far as its administrative and financial arrangements are concerned, is generally similar to the other schemes which have been outlined in our pages. A committee consisting of Sir A. B. W. Kennedy and Mr. G. W. Partridge, appointed by nine of the principal electricity supply companies within the area, Mr. J. H. Rider, appointed by the L.C.C., and Mr. C. H. Wordingham, by the Conference of Local Authorities Owning Electricity Undertakings in Greater London, was formed in May, 1920, to prepare the technical part of the scheme, and has had the co-operation of Sir Philip Dawson with regard to railway electrification and power demands therefor. What follows is an abstract of the report.

The area of supply, as provisionally determined by the Commissioners, contains approximately 1,700 sq. miles, with 84 separate electrical undertakers (omitting independent electric railway and tramway systems) operating some 77 different power stations. The systems of generation comprise d.c., single-phase, two-phase, and three-phase a.c., generated and supplied to the consumers at a number of different pressures and frequencies. In certain outlying parts of the area no supplies at all are given at present. The aggregate maximum demands (excluding separate railway and tramway systems), have been as follows:—

Year.	kW.	Millions of Units.	Load Factor, per cent.
1913-14	240,700	454	21.5
1917-18	293,000	653	25.4
1919-20	320,600	606	21.6

During 1919-20 70 per cent. of the units were sold within the County of London, and the total amount of generating plant in the various power stations at midsummer, 1920, was as follows:—

	kW.
At work or available	(about) 480,000
In course of erection, on order, or sanctioned	(about) 255,000
Total	(about) 735,000

The whole of the plant which is now in course of erection, on order, or sanctioned, is of the modern turbine type, mostly of sizes varying from 5,000 to 10,000 kW. The value of this new plant is about £4,500,000. The average actual works

* Elec. Rev., p. 169, Feb. 11th, 1921.

cost of generation, excluding rents, rates, management, and capital charges, has been as follows:—

Year.	Works costs per unit sold.
1913-14	0.69 d.
1917-18	0.99 d.
1919-20	1.55 d.

The average fuel consumption (so far as can be ascertained) expressed as B.th.u. per kWh generated, during the last recorded year, was 38,900 B.th.u. The lowest consumption was 27,000 and the highest 92,000 B.th.u. per unit. The above average figure corresponds to a consumption per unit of about 3.7 lb. of fuel, having a thermal value of 10,500 B.th.u. per lb. Even before the war, the capital charges (including interest, sinking fund, depreciation, &c.) amounted, on the average, to no less than about 50 per cent. of the total price charged to consumers, and this percentage is likely to be still further increased.

The growth of demand within the area over the last four or five years has been at the rate of about 18,000 kW per annum, but the total demand, by the time that any capital stations can be ready, will have increased from its 1919-20 amount of 320,600 to about 470,000 kW, and by 1931, the demand may have increased to about 600,000 kW. These figures are independent of the probable railway demand, which, if it were supplied from the general system, would add, according to the estimates of the railway companies themselves, about 200,000 kW by 1931. If these figures be justified by events, the total demand ten years hence will be about 800,000 kW.

The average annual load factor has changed very little during the last ten years, in spite of the fact that the industrial load, including heating, now takes up a much greater proportion of the total power than it did ten years ago. During the last two years the maximum load has increased by 27,000 kW, while the units sold have diminished by over 45 millions. The committee made a detailed examination of what the possible diversity factor over the area of supply would be if all the principal undertakings were to be supplied from one single source. Even in this case (an impracticable one) the diversity factor would only amount to 1.07. That is to say, the sum of the maximum demands upon the various individual stations would only be 7 per cent. greater than the combined maximum demand upon a single station. Under any actual conditions, therefore, with several generating stations at work, it would not appear large enough to make any appreciable difference in cost of plant. Naturally, if tramway or railway loads (having perhaps a 40 per cent. annual load factor) were at the same time carried by the single station, its average load factor and, therefore, especially its economy in capital charges per unit, would be increased.

For the first stage of the scheme, the committee recommends that the power stations in the whole area (apart from certain outlying stations and districts which have to be dealt with separately), should be divided into groups, within each of which generation would be continued in certain power stations ("auxiliary power stations"). These stations would be linked together and would serve, for the time being, as bulk supply stations for the remaining power stations in the group, which would then cease altogether to be generating stations, and become sub-stations. The supply in bulk to the closed-down stations would be given through secondary high-pressure mains, the current being transformed to l.p. d.c. or a.c. for local distribution. The mains interconnecting the various stations of each group would work either at about 6,600 or 11,000 volts.

The second stage of supply would commence when capital stations were ready for work; these stations should supply at 33,000 volts, and should be connected to points in the area (in most cases the sites of the now existing power stations) where the e.h.p. would be stepped down to the secondary pressure, whatever that might be. When this condition had been reached, it would be possible economically to shut down more of the older power stations which had been kept at work, and to substitute for their generation the supply of stepped-down current from the capital stations.

The first stage of the scheme may possibly be completed in 1925-26, or at the earliest date at which bulk supply can be given from the capital stations; the total fuel saved at that time, over the whole area dealt with, will be at the rate of about 500,000 tons per annum, as compared with the quantity which would have been consumed with the same output had the conditions of 1919 continued.

By providing e.h.p. interconnecting mains between them the different portions of the area could be, if necessary, completely separated at times of peak load, so that the consequence of any serious failure of mains or plant would be localised as much as possible, while at times of light load the auxiliary power stations in certain portions of the area might be shut down, and the supply taken entirely from the capital stations. Further to minimise the effect of any local breakdown it is proposed that each capital station should be subdivided into two or more entirely separate sections, each complete in itself as regards boilers, generators, condensers, transformers, and switchgear. These sections would be arranged so that they could be disconnected or connected as and when required.

During the second stage of the scheme two of the existing power stations which are advantageously situated for their special requirements should be practically reconstructed and enlarged, utilising the new plant which is at present going into them, and extended with further new plant. They would then serve as capital power stations. This work should be completed at any rate within about ten years from the formation of the Joint Electricity Authority. It is probable that it may be desirable and economical to transfer certain plant (in large units) from stations which it is thought on the whole ought to be closed, to others which would be continued in operation for some time.

There should be a control centre for each group of power stations, where an engineer-in-charge would be in telephonic communication with all the power and sub-stations within the area of his group, and must have complete responsibility for the distribution of the load at different hours and on different days, between any stations in the area which were at work. This is necessary especially to ensure that the highest load factor should be given to the plant which could be most economically worked, while other plant or other stations were utilised at times of peak load. A central control for the whole of the area must further be able to prescribe the method of working as between the different groups. This system of control would have to come into effect as soon as the capital stations were at work. In each group control, and especially at the central control, it is desirable that there should be visual signalling arrangements which would tell the engineer-in-charge exactly what station or plant was working at any particular moment, and how the output was apportioned.

Both the power stations and trunk mains should come under the control of the Joint Electricity Authority when it is formed, whether the systems be purchased outright, or taken over in some other way, and it has also been assumed that the local distributing powers would remain for some extended period entirely in the hands of the present undertakers. Arrangements might be made with some of the railway companies now owning power stations, or which might build power stations primarily for their own needs, to erect additional plant and to give a supply to the Joint Electricity Authority.

The most advisable pressure of supply on the e.h.p. mains from the capital stations is 33,000 volts between conductors. Wherever possible, the system of laying 3-core armoured cables direct in the ground should be adopted, except, perhaps, in some of the outlying portions of the area where overhead conductors could advantageously be used; it may be advisable to use single-conductor cables in some cases where the 25-cycle system is employed. Considering the difficulty of laying and jointing mains in the Metropolitan area, of obtaining access in case of faults, as well as the possibility or necessity (in certain cases) of using a draw-in system, it is necessary that the number of cables and the pressure between the conductors should be kept as low as is economically possible.

Energy at 33,000 volts would be transmitted from the capital stations to certain selected points in the various portions of the area, at which it would be stepped down to 6,600 or 11,000 volts, as the case might be, and paralleled with the supplies from the auxiliary power stations. Authorised distributors would receive the supply at either 6,600 or 11,000 volts in the form of 3-phase energy, and any transformation beyond that, either to 2-phase alternating, to l.p. d.c., or to l.p. a.c., for distribution purposes, would take place either at existing sub-stations or at existing power stations used afterwards as sub-stations. The energy supplied by the Joint Electricity Authority would be metered on the 6,600 or 11,000 volt side at the sub-stations. The standard frequency for the area on the north side of the river Thames should be 50 cycles per second, but on the south side of the Thames, both 50 and 25 cycles should be available, owing to the fact that, at the present time, a much greater proportion of the power and traction supply on the south side is given at 25 cycles than at 50 cycles. Interconnection between the two different frequencies, if it should be required, could be carried out by suitable frequency changers installed in sub-stations or in power stations. Such frequency changers have been in use in the London area for a considerable number of years, and are to-day being manufactured up to sizes of 5,000 kW.

During the development of the first stage of the scheme the erection of four new capital generating stations would be commenced, three on the north side of the river Thames and one on the south side. The second stage of this scheme would begin as soon as these stations were at work. Three of the sites are to the east of Blackwall Tunnel, and one is an up-river site.

The creation of obligatory sinking funds, in many cases for comparatively short repayment periods, is likely seriously to affect the ability of the Joint Electricity Authority to sell electrical energy to railway companies at a price as low as such companies could produce it in their own stations. The probable extent of the railway load has already been mentioned, and its acquisition by the undertaking of the Joint Electricity Authority is of paramount importance, and this point should be impressed upon the Electricity Commissioners with a view to a reconsideration of the whole matter.

The cables will be three-core, paper insulated, lead covered and armoured, and will generally be laid direct in the ground; in special cases unarmoured cables will be drawn into ducts, and the sizes used will be 0.15 and 0.25 sq. in. In certain outlying parts of the area overhead transmission may be adopted. During the first stage it is proposed to shut down progressively 34 generating stations, and, by means of inter-

connecting cables, to supply such stations in bulk from the remaining stations. At the same time certain capital stations would be erected, and, as these became ready for work, the second stage would be reached. Twenty-six of the remaining generating stations would then be progressively shut down. Of the remaining 17 stations existing in the area, two would be reconstructed and considerably enlarged to act as capital stations, and seven would be permanently retained to act as auxiliary generating stations in conjunction with the new capital stations. The other eight, near the outskirts of the area, would have to be kept at work for a considerable period until it became commercially possible to extend the transmission mains to their neighbourhood. The installed capacities of the capital stations would vary, in the first instance, between 70,000 and 200,000 kW, mostly in units of 25,000 kW. Several of the sites would permit of much larger stations if required.

It is not proposed that any works should be constructed by the Minister of Transport, under Section 18 of the Electricity (Supply) Act, 1919.

It is proposed to leave the existing generating station (tramways) of the London County Council (Greenwich), and the existing generating stations (railways) of the Underground Railways (Lots Road), Metropolitan Railway Co. (Neasden), Great Western Railway Co. (Park Royal), London and South-Western Railway Co. (Wimbledon), and London and North-Western Railway Co. (Stonebridge Park), to supply energy as heretofore to their respective systems.

In most cases the plant at these stations is already fully loaded, and no good purpose would be served by incorporating it in the general system of supply; moreover, two of the stations, viz., Lots Road and Neasden, supply at a non-standard frequency of 33⅓ cycles. Any railway system in the area, not already electrified, would be able to obtain its supply of energy from the new capital stations, while additional supplies could be given from them to those railways already electrified. On the south side of the river Thames supplies at either 25 or 50 cycles would be available, and on the north side a supply at 50 cycles.

The estimated capital expenditure by the Joint Electricity Authority for the first stage of the scheme, ending 1925-26, is: (*a*) Secondary transmission and interconnecting mains, including switchgear and transformers, £2,050,000; (*b*) primary transmission mains from capital stations, including switchgear and step-down transformers, with buildings, £2,000,000; (*c*) capital stations (first portions of) (200,000 kW installed capacity), £8,000,000; and (*d*) interest on capital during construction (say), £1,000,000, the total being £13,050,000. For both the first and second stages, ending 1930-31, it is as follows: (*a*) £2,550,000; (*b*) £4,700,000; (*c*) 875,000 kW installed capacity £22,000,000; and (*d*) £1,500,000, the grand total being £30,750,000. The above estimates are based on present-day prices, but do not include the cost of the acquisition of existing generating stations or of existing interconnecting mains.

THE HEATING OF BURIED CABLES.

Discussion at Liverpool.

The N.P.L. report on the above research work, which was abstracted in our issue of December 31st last, was discussed before the Liverpool Sub-Centre of the North-Western Centre of the Institution of Electrical Engineers on February 7th. Mr. E. B. Wedmore introduced the report, and was followed by Messrs. Melsom and Fawssett, and Dr. Marchant, who each in turn introduced his contribution to the research work.

Mr. J. A. Morton opened the discussion, pointing out that the report left the information in such a form that it was not readily available for use by cable users, although it was useful to the manufacturer. They wanted tables or simple formulæ. Now the ground had been cleared in that preliminary report, the question was what next to do to bring about that desirable consummation. Dealing with paper cable, it would probably be necessary to obtain lengths of armoured cable built to the B.E.S.A. (July, 1919) standards (preferably all from one maker), a small, medium, and large size of each type. Temperature rises could be obtained in earth with a certain moisture content and depth, and corrections would be made to certain agreed standard K values of dielectric and soil, and tables built up like those prepared by Mr. Melsom for the I.E.E. Wiring Rules giving currents for, say, 60 deg. and 90 deg. F. temperature rises in the different types of armoured cable, laid direct. Possibly Mr. Melsom could arrive at multiplying constants for different thermal resistivities of dielectric and soil, by which the standard figures in the table could be modified as required. Those experiments would also show how long the different types of cable took to reach their steady temperature, a point of some importance, which was not sufficiently dealt with in the report. They should want some cooling curves also, for the rate of cooling would probably not be the same as the rate of heating. He also thought that they might try the effect of laying from three to six three-core cables in the same trench at, say, 6 in. centres, which would enable constants to be obtained for multiplying the one-cable currents to provide for more than one cable in a trench. The consideration of dielectric heating at 20,000 volts or over was not necessary, because different makers used different compounds for impregnating their cables, giving different electrostatic capacities and different dielectric power factors. With regard to e.h.p. cables, makers could draw up their own tables for safe currents in the copper, based on the committee's tables, but making their own allowance for dielectric heating in their own cables. The portion of the report dealing with bitumen cables was excellent, and very complete so far as single cables laid solid were concerned, and he did not think anything more needed to be done on those lines, but bitumen cables were largely used for mining work, for running down pit shafts, and he thought experiments might be made on such armoured cables run vertically, say, 6 in. from a wall, such as would be the case in a pit shaft, to find out what current could be carried for a 40 deg. F. rise, which was about all that could be allowed in that class of cable. It had been usual to take the ground temperature at 60 deg. F., although it would sometimes be rather higher in summer, but seeing that the heaviest loads were usually in the winter months when the temperature was lower than normal, he thought 60 deg. F. would be a good figure to work upon. There was also the permissible maximum temperature rise to be allowed, and so far as paper cables up to 11,000 volts were concerned, 90 deg. rise (from 60 deg. F. initial temperature) was quite all right, but one had to take account of the longitudinal expansion of conductors on the long lengths of cable as now made. Generally a 60 deg. F. rise was sufficient, because the expansion in a 220 yards length of copper with a 60 deg. F. rise was 4½ in., which was quite enough to deal with if they were not going to use expansion joints. Of course, all the expansion did not occur at the end of the cable; if it did, 60 deg. F. would cause trouble. Large expansions distorted the lead, which was not elastic, and might cause trouble, in fact, it had caused trouble in certain cases. For cables built for, say, 20,000 volts and over, probably 60 deg. F. rise (*i.e.*, a maximum working temperature of 120 deg. F.) was sufficient, because above a temperature of 120 deg. F. the dielectric losses tended to rise quickly, though possibly that might be got over by the cable makers in the near future. The great difference between the K values of the l.p. and h.p. cables brought into prominence for the first time the importance of the thermal resistivity of the dielectric. He did not think that they ever realised before the importance of that, and he did not see why the l.p. K values should not be brought more in line with those for h.p. cables. What about the K values of the jute servings over and under the armour? Nothing appeared to be said about those in the report. Apparently the effect of armouring was of little importance on the heating, though the figures related to cables in air, and showed that when the armour was removed the temperature rose slightly. He would have imagined that if the cable was buried in the earth the armour would act as a lagging, and they would get the opposite effect, but apart from that it did not follow that the dielectric round the conductor had a lagging effect. It had been found from experiments with bare cables in air that a braiding of cotton soaked in ozokerite tended to cool a small wire, while with a very large cable similar braiding acted as a lagging, and on some intermediate sizes the braiding had no effect at all one way or the other upon the carrying capacity of the wire; a little more light on that subject might be useful. The K value of the soil for general work in Great Britain might be taken as 100 which meant that the soil contained about 12½ per cent. moisture. A very dry soil might reduce the carrying capacity of cables by 25 per cent., and there were places in this country where that might be the case. Three-core cables with shaped conductors would carry about 3 per cent. more current than a similar cable with round conductors, and cables in ducts would carry less than armoured cables laid direct, the actual amount depending on the diameter of the cable in relation to the duct. It seemed that armoured cables buried in the earth had the advantage from every point of view. The report said that there was no appreciable difference between the heating effect with alternating (50 periods) and direct currents, which was what they had always thought, but some little time ago Major Taylor, at Birmingham, discussed that question and caused rather a flutter in certain quarters. He apparently showed that the sheath loss of a.c. 3-core cable might be 50 per cent. of the I^2R losses in the copper of an unarmoured cable, but he (Mr. Morton) did not think a true comparison had been made. Major Taylor should have taken 230 amps. d.c. per core, *i.e.*, in all three cores as in the a.c. test (instead of 400 amps. in one core), and he would have got a different result; one which would come nearer that of the committee; Major Taylor's conclusions seemed to be at variance with all previous work on the same subject.

Mr. G. H. Nisbett said that the report contained far too many variables to be of any ready use to users of cable, although he appreciated the value of the research to the cable maker. One could not safely generalise, but to take an example: For a 33,000-V cable with a load of 167 amperes per phase, the annual cost of the energy lost and the interest and depreciation added together approached a minimum figure for sizes between 0.1 and 0.25 sq. in. of copper; between those sizes the total annual charges did not vary very much, even with considerable variations in the price of copper and the cost of energy. That being so, a

supply engineer would install the larger cable, and in that way avoid all possible over-heating, and so would never need to bother his head about the figures in the paper, except in cases where a miscalculation had been made about the possible load. Mr. Melsom suggested that the measurement of the resistance of the lead sheath would be of considerable use in practice to ascertain the temperature of a cable already laid, but it would seem that Mr. Melsom was much too sanguine, and did not weigh up the difficulties to be met with. Mr. Melsom drew attention to the relative heating of h.p. and l.p. cables of the same copper section, and pointed out that a h.p. cable in air was the cooler of the two. The opinion that when the cable was laid the difference would disappear was probably true, but attention should be drawn to the fact that the test was not sufficiently long to produce heat saturation in both of the cables, as the curves were approaching each other when the test was discontinued. The object of the cable-insulating paper test was not very apparent, the temperature used being far above the limit that any cable maker would guarantee his cables to work at.

Mr. W. P. Fuller outlined seeming discrepancies in the application of some of the formulæ in practice, and offered suggestions for a more accurate determination of those formulæ. For instance, the thermal resistivity formula for 3-core cables was the same as the formula given by Russell for the capacity of three cores to the lead sheath, with the addition of the 4π constant. The formula, however, gave capacity figures which were too low by from 20 to 30 per cent., and it seemed possible that, if the correct relationships between the size of conductor, &c., and the thermal resistivity were known, the 3-core figures and those for single-conductor cables would more nearly harmonise. A great deal of attention had been paid to thermal resistivity, but there was another thermal constant (the specific heat) of which he saw no mention in any paper. To show its effect, in a 0.15 sq. in. 3-core, 20,000-volt cable working at 250 amperes, if the current were raised to 300, even if none of the extra heat generated were conducted away from the cable, it would take an hour and a quarter to raise the temperature of the cable 10 deg. F., although the final temperature of the cable from the authors' fig. 6 would be enormous; therefore, in estimating the overload capabilities of a cable, the thermal capacity came in materially. The thermal capacity of the ground, in the case of buried cables, was as important as the resistivity. He did not believe a cable laid in the ground ever reached a steady temperature, as a matter of fact, all the curves in the report were still rising. With cables in air, convection so arranged matters that heat was carried off as rapidly as it was generated, and so a steady temperature was reached, but such was not the case with a cable buried in a fixed medium. It might be a good idea to give curves of temperature rise and time for different diameters of lead piping at different watts loss per square centimetre of surface. One could then work back and find the temperature of the copper, by using the steady results obtained with the cables in air. The authors anticipated making experiments on cables with applied voltage, a different state of affairs to that of a cable carrying current alone. In the latter case the maximum temperature was next to the copper, but when voltage was applied, it was likely that the maximum temperature would shift to the centre of the cable.

Mr. F. J. Teago suggested that co-ordination of the information might be obtained by a close study of the manufacture of the different classes of cable. Temperature rise was closely bound up with the intimacy of contact between the various dielectrics and the copper, and the inclusion of slight air films caused banking of heat pressure, that was, greater difference of temperature between interior and exterior.

Mr. W. Holttum thought the report did not give much definite guidance to cable users or manufacturers. The research, as so far conducted, had been mainly directed to the cables, but there was very considerable room for further investigation, not only regarding the nature of the ground in various places, but of the behaviour of the ground when occupied by warm cables. In many cases cables in continuous use would maintain the ground in average weather in a condition continuously different in its heat dissipating qualities from the normal. It seemed likely that a special piece of apparatus for ground tests would be more useful than an ordinary cable; for example, a spherical unit containing a heater and means for taking continuous observations of its surface temperature, also a number of buried thermo-junctions or other convenient apparatus for taking the temperature at various distances from the heating unit, and some form of buried moisture indicator if such could be devised, would be very useful adjuncts. The nature of the contact of the cable with the ground was of considerable importance, and there seemed room for trials to be made with identical cables in identical earth, but with the earth in different degrees of contact with the cable. Also the effect of slightly wetting the ground while laying and before ramming down might be determined, tests being taken after normal dryness had been reached; watering the ground during laying with a solution such as calcium chloride might, in certain cases, yield profitable results. With regard to determinations of thermal resistivity of the dielectric, was it not possible that the wide variation in the results given was accounted for, not by actual differences of thermal resistivity, but by differing degrees of intimacy of contact between the paper and the copper and lead? It would appear desirable to investigate that factor by experiments on artificial test cables, in which the copper and lead were replaced by mercury.

Messrs. Wedmore, Fawssett, Melsom, and Dr. Marchant replied to the various points raised by the speakers, and expressed appreciation of the various suggestions put forward, which would be reviewed in more detail when the full report of the discussion was available.

GAS v. ELECTRICITY.

Under the auspices of the National Association of Supervising Electricians, a debate on the respective merits of gas and electricity was held at St. Bride's Institute, Fleet Street, on March 9th; Mr. J. S. Highfield, M.I.E.E., occupied the chair.

Mr. F. W. Goodenough, of the Gas Light & Coke Co., opened the case for gas, and said he was sorry to appear as the representative of an industry which, according to some of its critics, ought to have been dead years ago. However, during his 18 years' experience of the industry he had come to the conclusion that after all there was room for both the gas and electrical industries in the service of civilisation. Each had its special field in which it was supreme, and the debatable ground was really very small. Therefore, each should recognise the other's usefulness. There were three fields of comparison for the two agents—illumination, mechanical energy, and heat. In the first of these three the physical limits of each had not yet been reached. There had been rapid improvement in electric lighting—gasfilled lamps, &c., but so there had been in gas lighting by the introduction of higher pressures, &c. The physical limits in the other two directions were known, but the speaker asserted that there were more possibilities of improvement in the application of gas as only from 25 to 30 per cent. of the heat units were used in the present types of gas engines. The heat equivalent of the electrical unit could not be improved upon, as it was a definitely fixed quantity. The gas industry now had to conform to a thermal unit in supplying its commodity. This was the "therm" or 100,000 B.th.u., and it would ensure a proper heat value for gas supplied. Returning to the lighting aspect, Mr. Goodenough said that many other factors, apart from efficiency, entered into the question. Renewals in the case of gas, *i.e.*, mantles and burners, were much cheaper than the replacement of electrical lamps. On the other hand, electricity was economical on account of the ease of switching off and on. Electricity was always more expensive than gas, but the efficiency was perhaps greater. Some housing authorities owning electrical undertakings appeared to think that electricity was the only satisfactory method of lighting, and had not considered the wishes of the users. As a proof of the fact that users would not always choose electricity, the speaker cited an instance in which 1,300 houses were erected for munition workers. These houses were wired for electricity and piped for gas. Upon a canvass being made among the prospective tenants, 1,289 were in favour of gas; only 11 required electricity, and, of these, five altered their minds. The chief reason for the choice of gas was that a working-class woman wanted an illuminant which would take the chill off a room.

As regarded power, a therm of gas would give from 10 to 12 b.h.p., according to the size of the engine—say, 11 b.h.p. —this was equivalent to about 10 units of electricity. Electric power had many incidental advantages, and even gas manufacturers used electric motors in their works for intermittent duties. Gas, however, proved best on regular loads.

For all heating purposes, a vast field remained with gas, although electrical authorities still put forward surprising claims for electric cooking. In this connection Mr. Goodenough quoted a letter written by Mr. Wright to the Electrical Review, in which young optimists of electrical sales departments were condemned for putting forward exaggerated claims for their apparatus, particularly with regard to electrical water heaters. A saving of meat was claimed for electrical cooking, these claims had been tested and found baseless—only moisture was retained, not nutrition. Some of the war-time National Kitchens were permitted to use electricity, but a letter from the Director stated that gas cooking had proved far more economical, and much further evidence could be given on this subject. A Blue Book issued by the Health of Munition Workers' Committee endorsed the statements made by the Director. Electric cooking was expensive both in initial and running costs. Electrical engineers would do their cause more good if they confined themselves to the many claims which they were able to substantiate; instead of this they endeavoured to kill the gas industry, which was the height of folly. There were many cases in which he would advise a consumer to use electricity; to others he would recommend gas. In conclusion, Mr. Goodenough hoped that his remarks would be taken in perfect friendliness in order to get at the truth of these matters, so that each agent could continue its service in its proper sphere.

Mr. W. A. Gillott, M.I.E.E., who had had his remarks printed and circulated among the audience, said that he proposed only to deal with the every-day use of electricity, and in the first instance would refer to a few of the salient advantages of electric light. In any situation when an

artificial light was required, none could be as suitable as electricity, and in certain cases only electricity could be employed, such as shop window cases, enclosed spaces as in explosive factories and coal mines, in submarines, cabins of airships, shops, strong rooms, and similar instances where cleanliness was necessary, pure air essential, and explosion or fire an impossibility.

It was well known that when electric light was installed the cost of decoration was reduced to a minimum. Further, in new buildings lower ceilings were permissible, owing to the fact that electricity did not vitiate the atmosphere or call for the necessity of improved systems of ventilation when employed in confined spaces. From a convenience point of view no artificial illuminant could approach electricity. One could have control of any light, or group of lights, from several positions, and individual lamps could be extinguished or turned down.

For accurate matching of colours, steadiness of light, purity, safety, convenience, definite results, and economy of operation, electricity undoubtedly commanded the complete situation.

For power purposes it was an established fact that the transmission of power by electricity was supreme, from the little motor in the domestic vacuum cleaner to the high-speed locomotive, or the minute dental motor to the enormous ventilation or pumping plants used for colliery work. The smallest or largest of motors could be started, slowed down, controlled, or stopped by the mere movement of a switch.

For industrial and small business purposes, its uses were almost inconceivable. A butcher used a motor to make sausages, a grocer to grind coffee, a works to drive machinery or lift articles weighing many tons and carry them to various positions and raise or lower them within a fraction of an inch. There were certain instances, especially in textile factories, where definite speeds were essential, owing to the possibility of the yarns breaking, if the machine was run at varying speeds, or intermittently. Electricity was employed there because it was so definite and reliable, and further, the output was considerably increased by its use. In large engineering shops it was the practice to employ one motor per machine, because electricity offered the facility of convenience of starting and stopping, the machine was only running when it was actually working, belt drives were eliminated, and it was economical. Upon the question of floor space alone it would pay in many instances to employ electricity; a 10-h.p. motor would occupy approximately 2 sq. ft., a gas engine of similar power approximately 15 sq. ft., even when disregarding the cooling tanks. Electric motors could be installed in almost any position.

The use of electricity for cooking was rapidly increasing because the users found it reliable, cleanly, economical, and definite in its results. During the last two or three years manufacturers of electrical cooking apparatus had introduced many improvements in the electric cooker; the open type boiling plate was doubtless the most important one so far as the used was concerned, it attained its full heat almost at once, performed its work quickly, the heat could be regulated, &c.

Housewives who used electric cookers were thoroughly satisfied with their behaviour, and would not use any other type of cooker. These views were identical with those of cooks who catered for upwards of 10,000 meals per day in the large electric kitchens.

Other advantages of electric cooking were: Cleanliness and absence of fumes; constant heating value, also the facility of reducing the heat to a definite degree, which was impossible with gas; reduced labour costs; less floor space required, owing to the fact that electrical apparatus could be installed in almost any position, and in some cases mounted on tables or one above the other; economy in food, *i.e.*, less shrinkage of meat; saving on renewal of kitchen utensils, and low maintenance costs.

Mr. Gillott gave a statement of the comparative costs of electricity and gas for cooking in private or domestic households. Over a period of 12 years many tests and comparisons had been made in all types of houses catering for from two to twenty persons, with an equally wide variation of the menu, and the comparative cost of fuel only, *i.e.*, electricity or gas was 1d. per unit or 2s. 6d. per 1,000 cu. ft., at a declared heat value of 500 B.th.u. per cu. ft. These were not laboratory tests, but records of actual instances under normal working conditions.

Room heating and water heating could be taken together for the purpose of the discussion. To use either gas or electricity for long periods was not economical. It was better to use a coke boiler for heavy duties, and "top up" by electricity.

Supplementing his printed remarks, Mr. Gillott asked: "Where is the dividing line between gas and electricity?" He was glad that Mr. Goodenough allowed that lighting belonged to electricity. Local conditions always had a great bearing upon any decision as between gas and electricity. The use of electricity in gas works was a fine testimonial to its efficiency. It was strange that gas engineers always expressed great indignation when electric cooking was discussed. The electric cooker of five years ago was nothing like that of to-day, and the gas companies were basing their remarks on out-of-date figures. Electric cooking was becoming more and more popular. In Newcastle the number of meals cooked electrically rose in a short period from 25 per week to 250,000 per day. Regarding costs, Mr. Gillott said that he used electricity in his home, while his neighbour used gas. In one year he (Mr. Gillott) used 8,000 B.O.T. units and four tons of coal, costing £32. In the same period his neighbour's costs amounted to £60, and he always had a dirty house. A restaurant with which he was acquainted formerly catered for 1,500 persons per day at an annual cost of £280. Electricity was substituted, and for £360 per year 2,200 persons were now catered for. In connection with the National Kitchens, the speaker said that the standard fixed for the cooking of meals was that a maximum of 3 cwt. of coal or its equivalent might be used for 1,000 portions. It was found, from results obtained in 50 kitchens in the Metropolitan area, that for 1,000 portions the coal equivalent in the case of gas was 3 cwt. 64 lb.; coal and steam, 2 cwt. 88 lb., and electricity 2 cwt. 28 lb. The speaker then exhibited a number of lantern slides illustrating various applications of electricity.

Mr. J. W. Beauchamp deplored the fact that the electrical industry fell far behind the gas industry in propaganda work and other things. The success of gas had been due, to a great extent, to the continual "urge" and advertisement of its sales organisation. Courteous and competent men were always ready to serve the consumer; this presented a great object lesson to electrical engineers. The business of electrical engineers was to "push" electricity and let the public judge. Mr. Beauchamp suspected there was something behind the continual desire of the gas people to institute these discussions. His opinion was that they were gradually leading up to an agreement of delimitation of the respective spheres of gas and electricity. There might be co-operation upon the generating side, but there could be none in distribution. The dividing line, if there was one, would be fixed by those who mattered—the public. He did not think the "thermal efficiency" type of propaganda was very fruitful, but it might leave an impression upon those in authority—who had considerably increased since the war; therefore this type of propaganda should be scouted.

Mr. Selley said that in 18 years of his experience gas had only increased in use by 44 per cent., while in 17 years the use of electricity had risen by 178 per cent. Under laboratory conditions the gas authorities could produce remarkable figures, but applied to household conditions the position was different. The installation of one electrical appliance led to the adoption of electricity wherever possible. Electric heating, because of its satisfactory performances, was causing great concern to the gas industry; in fact electric heater manufacturers were making fortunes. (Laughter.) Electric radiators were remarkably efficient, although their first cost was often prohibitive. Mr. Selley spoke at some length on the many other advantages of electricity.

Mrs. Cross said that, as a cook who had used both methods, she found electric cookers very much easier to use, cleaner, and more economical. She did not get half so tired when cooking electrically, and the food tasted much nicer. In cooking 100 joints in several ovens she had found the average loss per joint to be only 8 per cent.

Mr. W. Nobbs referred to a chart prepared to give a just indication of the relation between various kinds of fuel heating. With gas at 5s. per 1,000 cu. ft., calorific value 450, used in a gas fire with 60 per cent. efficiency, the cost of 100,000 B.th.u. was 2s. Electricity used at 100 per cent. efficiency, and at 1½d. per unit, cost 3s. 6d. But apart from this there were many other considerations, such as annual charges, attendance, and cost of flues, which gave electricity a 33 per cent. advantage in cost.

Mr. Mason rather objected to the use of lantern slides by Mr. Gillott. Mr. Beauchamp inferred that the discussion was arranged by gas interests; this was not so; the secretary of the Association had organised it. The first electricity supply stations had been worked by gas engineers, and it was a national disaster that they should ever have fallen into separate camps, as there was a lot of time wasted in recriminations. The speaker waxed facetious over Mr. Gillott's description of an "electrical day," and his parody evoked a great deal of laughter. He compared the two industries with the two great English-speaking nations, and said that in many ways electricity was like the United States—standing for vital progress. Electricity had a great future before it—but so had gas. Some politicians were holding up to the people the ideal that electricity was going to bring about a new heaven and earth; it was going to do nothing of the kind. As a policy the gas interests never said anything against the electrical industry, stated the speaker, amid much laughter, except, he was careful to add, when electrical engineers said something that wasn't true.

Mr. Carter pointed out that the heat value of the B.O.T. unit was constant, and although the gas value was to be standardised, the thermal value would vary. Electrical apparatus would always give the same results—provided the voltage remained constant. The calorific value of gas depended on the fuel, and the consumer had to bear deficiencies. Electrical engineers had fuel trouble also, but their consumers did not have to stand this.

Mr. C. Nobbs supported the last view, and he also stated that gas companies were supplying gas to about 500,000 h.p. of engines—a mere fraction of the electrical power in use. Electricity propaganda was only just commencing, but state-

ments of the gas authorities were often misleading, and should be watched. There was no dividing line between the two industries.

Mr. G. D. Bird, speaking merely as a consumer, said that the cost of appliances told heavily against the electrical industry, but their convenience kept down the balance from a woman's point of view. The electrical industry had to contend against the appalling ignorance of electricity shown by the working classes. It was to be hoped that the increased output of electric appliances would cheapen them.

Mr. Goodenough, replying to one or two points raised, said he appreciated the courtesy shown to him, but protested against Mr. Gillott's statement that he (the speaker) had said that electric lighting held the field. Regarding the electric cooker, it seemed that "Man never is but always to be blest." Progress was still being made in gas cooking, and the speaker had seen electric cookers with gas hot plates for water heating. The Newcastle restaurant mentioned by Mr. Gillott still used gas as well as electricity, probably to the extent of 50 per cent. He remembered that an "all-electric" kitchen at Earl's Court some years ago used 250,000 cu. ft. of gas as well as coke. The danger of gas poisoning had been mentioned; statistics proved that the cases of gas poisoning were only one per annum per 2,000,000 gas users. Regarding the alleged constant efficiency of electrical apparatus, was there such a thing as varying voltage? or had he been misinformed? He reminded the audience that the reduced quality of gas was the result of attention given to the extraction of benzol and toluol, which had practically won the war.

Mr. Highfield thanked the speakers, and said the discussion had elicited many important facts. Both industries were partly controlled by the Government in their business, but he was envious of the gas people, who could evade the Government so easily. Both depended on the customer—and both got the better of him, although it was not always so, as witness the case of the Holborn street lighting some years ago. The chairman concluded by thanking the secretary (Mr. Revell) for the able way in which he had organised the meeting.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sexton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

6,009. "Telephone repeaters." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 23rd.
6,248. "Cover for electric light switch on motor-cycles." L. C. Hughes. February 24th.
6,272. "Apparatus for electrically welding flanges of metal rims or wheels." G. Giorgini. February 24th.
6,278. "Protective devices for alternating-current electric distribution systems." British Thomson-Houston Co., Ltd. (H. Trencham). February 24th.
6,279. "Electric distribution systems." British Thomson-Houston Co., Ltd. February 24th.
6,285. "Telephone instruments." S. A. Lazarus. February 24th.
6,288. "Winding devices for paying out and winding in electric conductors." N. D. G. Robertson and R. D. Stowell. February 24th.
6,315. "Lock for electric lifts." G. Newbury and H. F. Thomas. February 24th.
6,326. "Automatic electric cut-outs." O. Szaszovszky. February 24th. (Hungary, February 25th, 1920.)
6,329. "Tapes for insulating cores of multi-core electric cables." H. R. Williams. February 24th.
6,335. "Lightning conductors." J. S. Borrington and F. Westwood and H. B. Westwood and S. C. Westwood. February 24th.
6,355. "Commutator brushes." J. S. Borrington. February 25th.
6,370. "Inverted voice current transmission." Western Electric Co., Ltd. February 24th.
6,381. "Electric lamps for motor vehicles." C.L.I. Manufacturing Co., Ltd., and E. A. Watson. February 25th.
6,388. "Rotors for electric generators." G. A. Juhlin and J. A. Kuyser and Metropolitan-Vickers Electrical Co., Ltd. February 25th.
6,390. "Feeding electric arc lamps for projection purposes." R. S. Wright. February 25th.
6,396. "Application of electric distance switches to locks in doors." Y. Remirto. February 25th.
6,407. "Magneto-electric machines." H. W. H. Warren and A. P. Young. February 25th.
6,442. "Electric cables." Johnson & Phillips and D. A. S. Porteous. February 25th.
6,443. "Mounting dynamo capable of acting as starting device in automobiles." E. Buggati. February 25th.
6,445. "Rectification of electric alternating currents." S. A. Pollock. February 25th.
6,451. "Electric hand lamps." J. Davison. February 25th.
6,461. "Labels for telephone transmitters." S. F. Smith. February 26th.
6,469. "Electric ventilating apparatus." A. Charles. February 25th.
6,472. "Electrolytic device for increasing speed of ships." E. Duteil. February 25th. (France, March 16th, 1920.)
6,473. "Roller brackets for commutator, &c., contacts of motor vehicles." F. W. Gowland. February 25th.
6,479. "Electric heaters." British Brass Fittings, Ltd., and H. B. Butler. February 25th.
6,483. "Watertight electric light fittings." J. Scott and J. Scott, Ltd. February 25th.
6,484. "Commutators for motor-car engines, &c." V. Franklin. February 26th.
6,494. "Electric manicure and chiropody machine." F. W. Flote and V. C. R. Pollex. February 26th.
6,496. "Adaptor for converting acetylene lamps into electric lamps." W. T. Harrington. February 26th.
6,507. "Electrical instruments." M. B. Field. February 26th.
6,513. "Electric welding." Metropolitan-Vickers Electrical Co., Ltd. February 26th. (United States, March 23rd, 1920.)
6,517. "Electrical liquid heaters." Festa Akt.-Ges. February 26th. (Switzerland, September 3rd, 1920.)
6,519. "Magnetos." Soc. Duten, Doublet et Cie. February 26th. (France, February 25th, 1920.)
6,520. "Electric cut-outs." J. H. Silley and H. J. D. Thompson. February 26th.
6,523. "Electric transformers." W. Parry. February 26th.
6,528. "Apparatus for registering telephone calls." E. H. Kinnard. February 26th.
6,540. "Electric signal for railways." I. Sanchez. February 26th.
6,548. "Electric switches." J. B. Tucker. February 28th.
6,561. "Spark-plug and magneto tester." C. E. Hall and W. H. Norris. February 28th.
6,568. "Emergency switch-gear in electric installations." J. T. Wright. February 28th.
6,575. "Terminal for sparking-plugs." A. Ford. February 28th.
6,585. "Electric heat radiator." S. B. Tax. February 28th.
6,586. "Combined electric call bell and automatic fire-alarm." P. W. Jones and J. Scott, Ltd. February 28th.
6,590. "Automatic, &c., telephone systems." W. Aitken. February 28th.
6,594. "Arc lamps." C. Beck and C. J. Beck. February 28th.
6,595. "Electric furnaces." A. Imberv. February 28th.
6,596. "Production of high-tension discharges and high-frequency oscillations." W. H. Wilson. February 28th.
6,598. "Production of high-tension discharges and high-frequency oscillations." W. H. Wilson. February 28th.
6,619. "Electrically-heated soldering-irons." W. Clark and Clark's Neo Electric Devices, Ltd. February 28th.
6,641. "Thermionic cathodes and manufacture thereof." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 28th.
6,653. "Applying X-rays, &c." E. J. W. Watkinson. February 28th.
6,654. "Controllers for alternating-current induction motors." J. Anderson and G. Ellison. February 28th.
6,655. "Electric storage batteries." Chloride Electrical Storage Co., Ltd. (B. Ford) and B. Ford. February 28th.
6,657. "Apparatus for compounding direct-current motors." Akt.-Ges Brown, Boveri et Cie. February 28th. (Switzerland, March 19th, 1920.)
6,671. "Electric switches." C. Hyland. February 28th.
6,712. "Electric light lamp sets for motor-cycles and side-cars." J. F. Smith. March 1st.
6,713. "Electric lanterns." J. Eaton and Efandem Co., Ltd. March 1st.
6,720. "Electric circuit-breakers." B. Thomas and E. Thomas. March 1st.
6,736. "Electric fuses and holders for same." J. J. J. M. Kluijtmans. March 1st.
6,738 "Electric switches." C. A. Damey. March 1st.
6,739. "Holder for incandescent electric lamps." A. W. Brown. March 1st.
6,756. "Electric-motor installations." Spencer & Co., Ltd., and M. W. Clarke. March 1st.
6,759. "Electric accumulators." Chloride Electrical Storage Co., Ltd. (B. Ford) and B. Ford. March 1st.
6,769. "Insulation of electric cables." C. J. Beaver and E. A. Claremont. March 1st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

19,370. "Electric battery lamps." Nurnberges & Sackier warenfavrik vorm. Geb Bing, Akt.-Ges. August 11th, 1916. (Germany, October 10th, 1916.)
19,393. "Electric protective arrangements." Akt.-Ges. Brown, Boveri et Cie. August 6th, 1919. (Switzerland, August 18th.) (130,993.)
20,960. "Telephone exchange systems." Western Electric Co., Ltd., and G. Deakin. July 28th, 1920. (158,592.)
21,885. "Electric water-heaters." Filbar Electric Heater, Ltd., and C. Kratt. September 6th, 1919. (158,595.)
24,246. "Electric heating apparatus." Automatic Telephone Manufacturing Co., Ltd., and C. H. Archer. October 4th, 1919. (158,604.)
26,777. "Sparking plugs of internal-combustion engines." J. Jones. October 31st, 1919. (158,615.)
27,255. "Elastic fluid turbines." British Thomson-Houston Co., Ltd. (General Electric Co.). November 5th, 1919. (158,630.))
27,398. "Protective devices for electric apparatus." British Thomson-Houston Co. (General Electric Co.). November 6th, 1919. (15,640.)
27,457. "Magneto-electric machines." R. B. North and A. M. Allen. November 7th, 1919. (158,652.)
27,462. "Electric cable connectors, particularly for use with car-lighting dynamos and the like." C. A. Miller, F. J. Miller and E. A. Sanders. November 7th, 1919. (158,654.)
27,464. "Electric lamps for motors and other vehicles." C. A. Miller, F. J. Miller and E. A. Sanders. November 7th, 1919. (158,655.)
27,498. "Electric lamp signalling systems." H. Hawkins, F. J. Hawkins, and T. Johnson. November 7th, 1919. (158,655.)
27,606. "Electrical testing apparatus." A. T. Scorey and Brella Manufacturing Co., Ltd. November 7th, 1919. (158,673.)
27,811. "Electrical insulators." G. V. Twiss. November 10th, 1919. (158,689.)
27,940. "Electric battery plate pasting machines." A. White (U.S. Light and Heat Corporation). November 11th, 1919. (158,701.)
27,950. "Wireless telegraph receiving systems." W. J. Picken and J. G. Robba November 11th, 1919. (158,707.)
28,320. "Thermionic or oscillation valves." S. R. Mullard. November 14th, 1919. (158,720.)
28,325. "Electric ignition apparatus for internal-combustion engines." N. C. F. Jensen and M. J. E. Tilney. November 14th, 1919. (158,721.)
28,599. "Electric transformers and the like." British Thomson-Houston Co., Ltd. (General Electric Co.). November 18th, 1919. (158,730.)
28,772. "Primary electric batteries." B. F. S. Baden-Powell. November 20th, 1919. (158,733.)
28,856. "Protective devices for alternating current electric distribution systems." British Thomson-Houston Co., Ltd., and H. K. Trechman. November 20th, 1919. (158,736.)
29,492. "Grinding and other machines having magnetic work-holders." W. Arter. December 28th, 1916. (135,856.)
30,285. "Protective casing or sheath for sparking-plugs when not in use." J. E. Goodwin. December 4th, 1919. (158,760.)
30,356. "Magneto-electric machines." British Thomson-Houston Co., Ltd., and A. P. Young. December 4th, 1919. (158,761.)
30,488. "Electro-magnetic wave reception apparatus." J. Robinson and H. L. Crowther. December 5th, 1919. (158,762.)
31,059. "Electrical switches." A. P. Lundberg, G. C. Lundberg, P. A. Lundberg, and G. Pegg. December 11th, 1919. (158,771.)

1920.

307. "Electric lamp holder." S. W. Hamlyn. January 5th, 1920. (158,787.)
392. "Means for driving dynamos." T. Davies. January 6th, 1920. (158,788.)
3,810. "Electric cables." H. Lucas and F. Jenkins. February 7th, 1920. (158,796.)
10,666. "Devices for protecting telephone, telegraph, and the like instruments against lightning or excessive electric potentials." A. E. Beattie. April 16th, 1920. (158,804.)
13,067. "Apparatus for extracting fuses or links on electric circuits." A. E. Wilson and Callender's Cable & Construction Co., Ltd. May 11th, 1920. (158,809.)
15,640. "Thermally-actuated electric switch." P. W. Baker. August 23rd, 1920. (158,812.)
19,496. "Receiving arrangements for the electric detection of fair-ways for shios." Siemens & Halske Akt.-Ges. September 18th, 1918. (147,564.)
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